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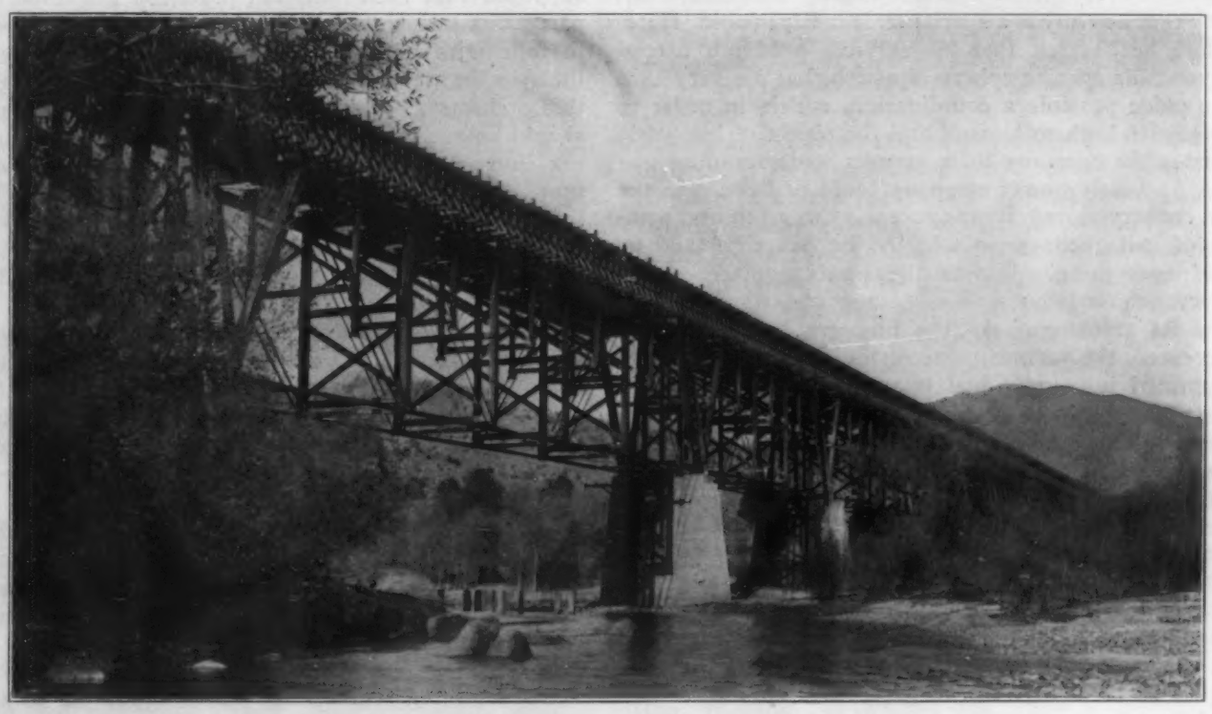
COORDINATION THE KEYNOTE FOR RESULTS

BY RUDOLPH W. VAN NORDEN,
Member A. I. E. E., A. S. C. E.

It is seldom one finds an engineer whose activities have brought him into that vast field of engineering science, the development of power for commercial uses, whether he name his particular class, civil, mechanical, electrical operative or commercial, who does not ride a hobby. Some specific detail in this broad and generally complex division or, better agglomeration of engineering thought appeals for some good reason or other to his sense of the importance of things and his work is known by the completeness and care of this especial part. The rider of another hobby criticises because his has been slighted and perhaps depreciates the value of the stress placed by the first on his work, and so on to the third and fourth.

The fact that each specialist believes and can probably prove beyond any reasonable doubt the importance of his specific branch of the power system, justifies the necessity for the work and care of each one.

But suppose each specialist, without reference to the others, were to so study and design his allotted part, giving his skill and experience an opportunity to play at their best, would the results for which the power system was developed be of a degree which may be justly expected from the combined efforts of these men? The answer is, probably not. This is an hypothetical question to fit, not necessarily a common condition of practice although there are certainly enough examples to justify such a question, but to suggest the necessity of a more thorough understanding; the importance of a more methodical method for correlating the action of these various parts; and for coordination between them that shall finally determine design and application, among the diversified engineers who enter into the work.



A Trestle and Timber Flume of Large Capacity in Southern California. The necessity for such a feature in a power canal may affect the entire design of the system and cause the adoption of features and methods of construction which otherwise or in another system might not be good engineering practice.

In the early day of power development the specialist came into existence as the result of necessity. For instance, the tangential waterwheel evolved to a

Intake to a Power Canal System in Washington. This diversion of great capacity together with a low and inexpensive dam, is a substantial concrete intake and regulating gate, delivering the flow directly into a timber flume, all of excellent design and construction. Complex limiting conditions, commercial, financial, topographical and operative determined the method of design.

high point of perfected design from a practice little better than guesswork. Similar examples could be made of every detail of the system. This specialist, now that he truly is a specialist, is indispensible. Heretofore he has felt that his services need not extend beyond his specific sphere of action, but his very skill has made possible a coordination, which, in order to do justice both to himself and the object of his work, creates the necessity for a broader understanding.

The early power company could be likened to the old country store. It was necessary to go to first principles. All goods were sold by the one clerk and he sold everything. It was the meeting place where everyone's opinion was respected and its simplicity was its salvation. As the business broadened and increased, the various parts of the country store were separated into individual stores which specialized in certain lines, shoes, hats, hardware, groceries and drygoods. This was simple evolution. And then came the third step when these specialists were again united into departments under a single business head and we had the department store. To conduct a department store successfully requires business skill of a rare order; insight into human nature; a thorough understanding of market and trade conditions; and, finally, a coordination which must be a perfect balance. In the realm of this business these points are understood as the essence of success in this line of commercial thought.

Another example: Supposing a great orchestra were brought together with the purpose of giving a series of symphony concerts. The object of this is, of course, the esthetic value, the education, moral uplifting, pleasure, entertainment, or exhibition, as the case may be, of the auditors. A secondary but equally important purpose is a possible pecuniary gain, for if there were not a showing on the credit side of the ledger the failure would be considered sufficient to prohibit a repetition of the venture.

Suppose, in this orchestra, that the musicians had been selected with the utmost care, each being an artist with his instrument, each possessing an instrument of the best make and value. Let is be further supposed that each musician practiced his respective part alone in his studio with his instrument, properly in tune with itself but pitched without reference to those of the other players. Let us further suppose that this orchestra, perfect in the execution of every part should be gathered for the first time to play the opening number of the initial program without having tuned together or having rehearsed together. The horns might drown the strings or the drums give a good imitation of an earthquake. But the audience would hear no symphony and the box office would be hurt worst of all.

The first of these examples is to show by comparison the breadth and importance of power plant engineering, not alone in its details but in the absolute necessity for cooperation and coordination of details to form an operating whole, a successful machine, commercially stated, as everything in engineering is eventually reduced to this basis.

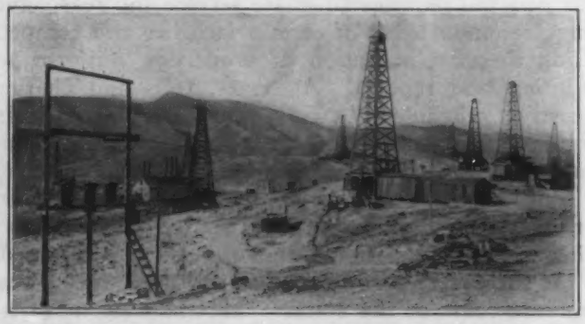
The second example is to better show the absolute necessity for this coordination and to bring out by its very absurdity a similar condition which may readily exist in the general question of power development engineering.

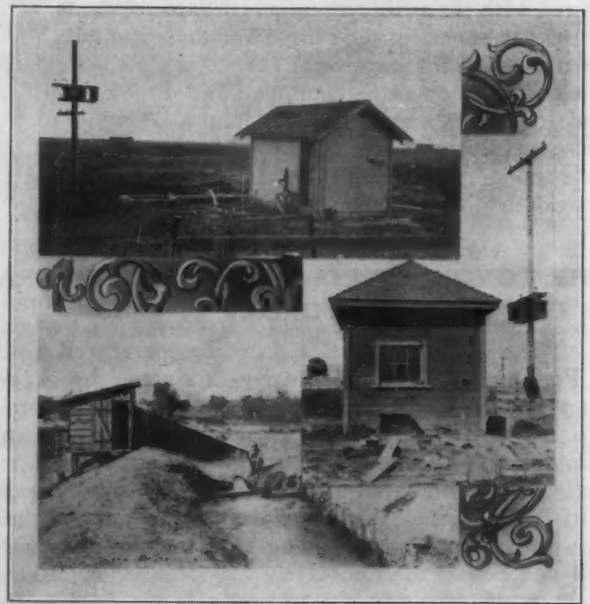
What has been written is an introduction. What is intended is a plea among practicing engineers to a freer and better undertsanding of the subject of coordination in power plant design. And the only method of getting this understanding is by a freer and more comprehensive study of existing works. Not necessarily to follow what was done, but rather to realize the many conditions and combinations of conditions which may present themselves, to profit by the errors or deficiencies which have developed and thereby to enlarge and elevate the general conceptions of power development work. There are probably many who read this, who will say, that every engineer has this very idea. Probably all do in a sense, but it is not carried far enough. Coordination in power plant de-

sign is not held on the high plane which its supreme importance deserves. Any engineer who will take the trouble to make a careful study of existing works will have ample proof of this contention.

A Power Canal in Southern California. This canal has a capacity of about 800 second ft.; it is built on a light grade and is lined with concrete. In many ways this was a daring work.

The importance of this subject affects primarily the general power plant engineer. He must in reality understand the method of thought pursued in every branch, electrical, civil, commercial, mechanical and operative. He must depend on the expert specialist. The specialist must then, in order to properly cooperate, make a study of coordination of parts.





Oil Wells Pumped and Drilled by Electric Power. Pumping Water for Irrigation. Widely differing load conditions, in which the power is supplied from the same transmission network. This distributes power in small lots over an enormous territory, and presents for this system a problem in plant design necessitating the utmost economy and yet a perfect service.

Probably the best method of establishing a community of understanding and the placing of this subject on a firmer footing is through the delivery and discussion of papers before our technical societies, the proceedings of which become records of value. It is useless here to enlarge on the efficacy of technical papers in general but only on the value of papers for the subject in hand, describing power plant practice.

There are every year books published on the general subject of power plants. Generally these give a number of examples of what is called practice. In our

A Half Mile Section of the Flume Shown in Fig. 2. This flume has a capacity of about 2,000 second ft. and is probably the largest power flume in existence. Its use at this point undoubtedly represents good practice.

schools and colleges these are used for text books and their influence is undoubtedly widespread. From time to time technical papers are written which are intended to show current practice. Some have been exceedingly interesting and valuable but seldom reach the high plane necessary to treat the subject in its length and breadth. Much can be taught and much learned in a paper so presented as to bring out a discussion on the general subject. In many cases, however, a discussion of this sort will degenerate to an argument on some point of detail which is quite foreign to the subject; points which, it is true, might in themselves be the subject of papers of the greatest value drawing enlightening discussions.

Papers describing new installations or even current practices must necessarily be brief due to lack of space and time on the part of the writer. They should deal not only with the trend of modern practice but with what may be considered as the best thought in the pursuit of this practice together with the reasoning. If this is not possible, then descriptive papers will be technically of no greater value and by no means as complete as the descriptions of hundreds of plants to be found in the columns of technical journals. Specialties and oddities in design of certain parts, due to unusual conditions are valuable only when these conditions are explained and this should be thorough enough to give a clear insight into the method of reasoning or to excite a discussion which shall bring it out.

What may be acceptable practice and good engineering in one place may be the utmost folly in another so that no fixed rules can be drawn. The

problem is always one for the engineer and the correctness of his reasoning is the rule for the economic result.

This may be illustrated in the design for a pressure pipe system for an hydroelectric plant. The design of a pipe for strength and carrying capacity is a simple matter, but the design of the layout for a specific set of service, financial or topographical conditions is quite different and may be a matter of much complexity. In the same manner, the mere statement that there are certain classes of dams and water conduits and that one type was used at one place and another type at another is most misleading and of little value. Where the use of these is an obvious necessity little can be said, but where their adoption is due to a proper coordination with all other factors is what should be brought to light.

The whole engineering profession is looking for papers that would describe perhaps only one installation but would give the why and wherefor of the design of each part, and not a mere statement of a few examples which stand together in their corelation like so many words in a dictionary. Our technical books and records are full of treatises on the design of details and we can never tire of any new development to be described, illustrated or worked out in any way. But let us put the great subject, which our Western engineers should be the most capable of understanding, that of power plant design, or power plant practice, or whatever else one may wish to call it, on the plane which it deserves. Let us have papers which will treat that subject in perspective, and then go to the details with the proper logic of their adoption. We have all learned a very little of these things. There is much more to be learned and a better and closer understanding held between every engineer interested in this work will do more to establish correct practice than anything else that can be suggested.

OREGON'S NEW PUBLIC UTILITY COMMISSION.

The Railroad Commission of Oregon has just been given jurisdiction over all public utilities in that state by a new law which was passed at the regular election on November 5, which extended the authority of the commission from railroads alone to all utilities. The bill was carried by a majority of about six thousand. Because of the fact that the bill will go into effect immediately, and in order that they may be able to take up the additional duties now placed in their hands, as soon as possible, the present members of the railroad commission will proceed at once to familiarize themselves with the new work.

The main features of this bill are taken from the Wisconsin Public Utilities Act as it was first passed by the Oregon legislature at its regular session in the spring of 1911. Certain representatives and state senators from Portland contended that the most desirable features of the Wisconsin law were not included in the one passed by the Oregon legislature, but aside from this there was very little other opposition and the objections were overcome and the bill was passed and declared a law. Certain persons in Portland, interested in "Home Rule" regulation, stirred up agitation shortly afterward and considerable opposition was then manifested in Portland against the new law. The same people brought up by the initiative petition a bill for a local public service commission for the City of Portland and the election on this bill was set on the regular municipal election in June, 1911. At the same time a popular referendum was invoked upon the state wide commission bill and this referendum was designed for the purpose of postponing the date that the state wide bill should become effective and of bringing it up to the people for approval or disapproval at the regular city election in November, 1912. In June, 1911, the Portland utility commission bill was defeated by a very small vote and the city was left entirely without regulation for over a year and a half.

In the fall of 1912, the same persons who endeavored to secure the passage for the Portland public service commission bill in 1911, prepared new petitions and had a similar bill put on the ballot at the city election on November 3, but this bill was defeated by an overwhelming vote for the reason that it was generally conceded that the state wide bill would pass on November 5, and the voters of Portland did not believe very strongly in a municipal public service commission.

The railroad commission of Oregon is now vested with the power and jurisdiction of supervising and regulating all public utilities in the state of Oregon. The new bill requires adequate service and reasonable rates, common using of certain facilities and compensation therefor, valuation of properties, uniform accounting and reports. All rates, tolls and charges shown on schedules of tariffs, which are filed with the commission, shall not exceed the rates, tolls and charges in force on January 1, 1911. The commission, in addition to its other powers, is also given the powers for investigations, hearings, etc., similar to those given other state commissions, and appeals can be made to the various state circuit courts and from there to the supreme court of the state. The commission is also vested with the authority to investigate accidents. The present members of the railroad commission which has been in existence for several years, are C. B. Aitchison, chairman; Thomas K. Campbell and Frank J. Miller, and its offices are at Salem, Oregon. Owing to the increased business which will naturally come from the extension of its jurisdiction, it will be compelled to provide additional office force.

THE COKING OF COAL AT LOW TEMPERATURES.

"The Coking of Coal at Low Temperatures, With a Preliminary Study of the By-Products," by S. W. Parr and H. L. Olin has just been issued as Bulletin No. 60 of the Engineering Experiment Station of the University of Illinois. This bulletin reports the results of experiments on various types of Illinois coal with reference to the principles which govern their use in the production of coke. The temperatures used did not exceed approximately 750 degrees F. Reference is also made to the by-products obtained at the temperatures employed. Copies of Bulletin No. 60 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

SCIENTIFIC PLANT MANAGEMENT

FIFTEEN FUNDAMENTALS IN EVAPORATIVE BOILER TESTS.

BY J. P. ZIPF.

By far the majority of boiler tests are made to determine the evaporative ability of a boiler. These tests may be incidental in determining more special characteristics—the fulfillment of a guarantee clause in a contract, the comparison of various types of burners or the effect of the rearrangement of baffles, furnace or other constructive features of a boiler. Before a test is made its purpose should be known. When testing for maximum efficiency it is advisable to make some preliminary runs, in order that the boiler may be in efficient working condition.

In order that the data taken during the test may not be indefinite, gauges, weighing scales, and thermometers should be calibrated before use, and recalibrated after the test for verifying the supposition that their error has remained constant during the test.

The piping should be so arranged that by a combination of valves and by-passes all the water and all the oil used during the test is conveyed to the weighing tanks. At the conclusion of the trial the boiler may be placed back in the line without any interruption in service. Means should be provided to definitely prove that neither water nor oil is supplied to the boiler unless accounted for. Thus, any leaks between the weighing tanks and the boiler should be accounted for and deducted from the weight of water (or oil) recorded as having been fed to the boiler. Separate feed pumps and supply tanks for oil and water should be provided, the plant auxiliaries being used to supply water and oil to the weighing tanks.

At the beginning of a test, the level of the water in the gauge glass is noted and an endeavor should be made to keep this level constant, especially so at the end of regular intervals, usually one hour. At the end of each hour during the test the water level in the supply tank is brought even with the mark at which it was at the time of starting the test; this is best indicated by the point of a hook gauge. This leveling will accurately mark the water weighed during the hour.

The weighed oil in the tank supplying the oil pump is brought to the point of a hook gauge at the time of starting and at the end of every ten or fifteen minute interval during the test. The consumption of oil and feed water for regular intervals determines in a great measure the uniformity of operation of the boiler, this being especially true for the oil consumption. In addition to the oil and water weights the following items are observed and recorded at intervals of ten or fifteen minutes:

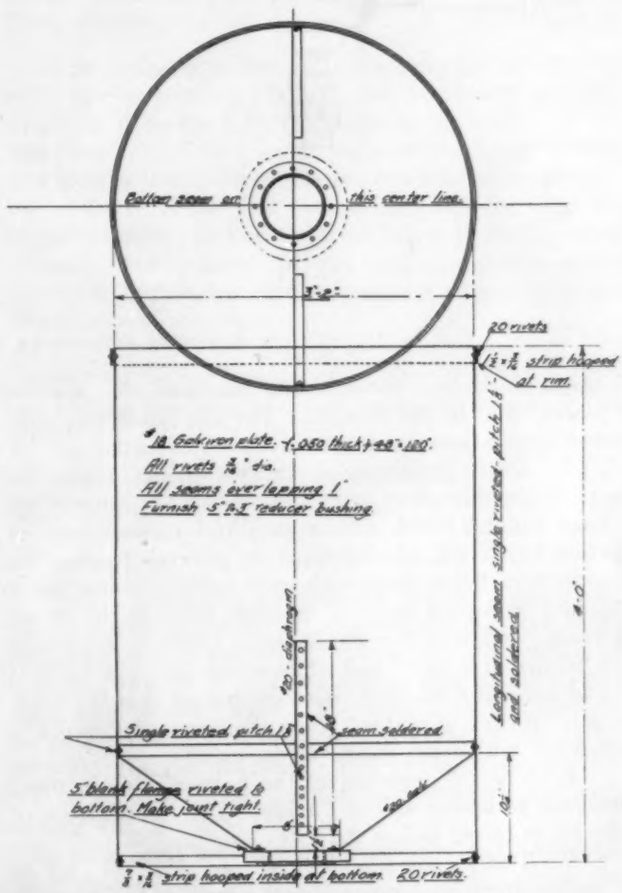
1. The saturated steam pressure is read on a gauge, usually the most prominent gauge on the boiler. Steam gauges are adjusted to read zero at atmospheric pressure.

2. The superheated steam pressure is read on a steam gauge if the boiler supplies superheated steam. If saturated steam is supplied, the quality of the steam must be obtained with a steam calorimeter of which there are two types in general use. The separating calorimeter, in which the moisture in a sample of steam is separated mechanically, and measured, or the throttling calorimeter, in which the quantity of moisture is obtained indirectly by observing the heating effect of the steam after it has expanded to atmospheric pressure.

3. The superheated steam temperature is observed on a mercury thermometer of high range. The thermometer is immersed in a thermometer well located in the steam main as near the boiler as possible; it should even be placed ahead of the boiler stop valve. If the thermometer stem is graduated for total immersion, and a considerable portion of it emerges from thermometer well the temperature as read may be too low by even as much as 12 degrees F. The correction for an emergent stem was given in this Journal March 30, 1912, page 285.

4. The temperature of the fire room and external air are taken for use in heat balance calculations.

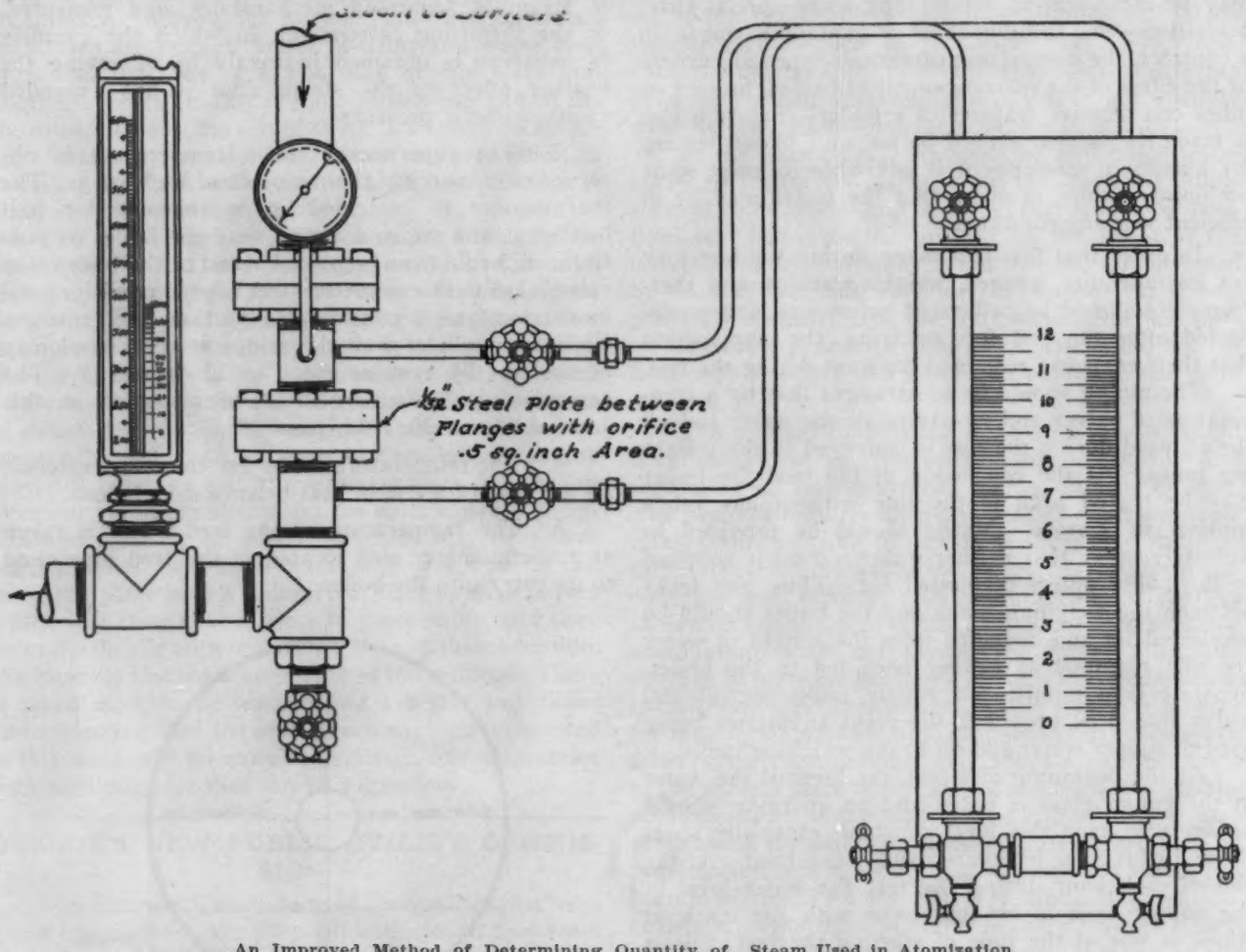
5. The temperature of the feed water is taken at a thermometer well located in the feed pipe close to its entry into the boiler.


Bottom seam on this center line.
20 rivets
1/2 x 2 1/2 strip hooped at rim.
All rivets 7/8" dia.
All seams over lapping 1"
Furnish 5" P.I. reducer bushing
Single riveted, pitch 1 1/8"
seam soldered
5" blank flange riveted to bottom. Make joint tight.
20 rivets

An Excellent Design for Weighing Tank in an Evaporative Test.

6. The temperature of the escaping gases is taken at a point in the breeching, preferably before the damper. The correct location of the pyrometer is important; it should be well in the path of the gases away from the influence of bends, and the cooler layer of gases near to the breeching. A mercury thermometer of high range can be used, but a thermo-electric pyrometer is most convenient and quite accurate.

on the two sides of the orifice, with steam flowing, is shown by the position of the ends of the mercury column against a suitable scale. The column should be calibrated in place. This calibration is accomplished by condensing in a barrel of water the steam passing through the orifice in a given period of time. The weight of steam condensed will be the difference in weight of the barrel of water before and after the



An Improved Method of Determining Quantity of Steam Used in Atomization.

Temperatures are some times taken at the various "passes" and in the furnace. For the latter temperatures a radiation pyrometer is almost essential.

7. Draft pressures at various points along the path of the flue gases are taken on a draft gauge. One gauge can be fitted with a manifold arrangement of pet-cocks to get observations at several points, the connections being made with good rubber tubing and a 1/8 inch iron pipe inserted through holes in the boiler setting, well into the flue gases. Draft is expressed in "inches of water," and while water may not be used as an indicator, the scale is so graduated that the reading is "inches of water" when the particular liquid is used for which the gauge is designed.

8. The oil pressure on the burner is maintained uniform to insure uniform firing. The temperature of the oil is taken before its entry into the burner.

9. The steam supplied to atomize the oil is usually determined indirectly on a mercury manometer or U-tube. The two legs of the U-tube connect to either side of an orifice in a thin plate located in the steam line to the burner. The differences in pressure

run. The data is then plotted, thereby forming a calibration curve.

10. For the comparison of burners the steam and oil pressures within the burner are recorded.

11. The barometric pressure is necessary to convert gauge pressures into absolute pressures.

12. The flue gas is analyzed during the progress of the test for an indication of the furnace conditions. The ordinary "Orsat" apparatus admits of analyzing the flue gas for carbon dioxide (CO_2), free oxygen (O_2) and carbon monoxide (CO), in percentage by volume of dry flue gas.

13. A steam flow meter, read every half minute, or minute, is a good indicator of the uniform operation of the boiler.

14. A log sheet should be kept by the person in charge of the test, and a record made of every item concerned with the operation of the boiler. The log sheet should include the date, time of starting and stopping the test, such boiler dimensions as are necessary, the condition of the fires, tubes, dampers, ash-pit doors, load fluctuations on the plant as a whole, etc.

15. An average sample of the fuel oil is obtained in a clean container—preferably a can with a screw top—for determinations of the gravity of the oil, its moisture content and calorific value. The container should be filled only two-thirds or three-quarters for convenience in the later laboratory manipulation.

When an efficiency test is contemplated the boiler should be overhauled if necessary, and the brickwork made tight. It should be fired at about rated load for some hours before the test is actually begun in order that the brickwork should be at an even temperature. The soot should be blown from the tubes just before putting the boiler on the steam line.

Data should be taken commencing about half an hour before the test is recorded as having been begun, as there are always minor adjustments to make in the draft, oil consumption, and condition of the fires. The water and oil weights should be started and stopped with precision. The other data should be taken at regular intervals, the assistants on the test observing a routine in reading their instruments. For instance, the one who reads pressures should start at the beginning of the time interval at a certain gauge and repeat this cycle in the same order throughout the test. The weighers should be careful in reading the scales and recording the weights correctly. On important tests an assistant should have nothing to do other than check the weights and calculations independently of the weighers.

RATE FIXING AND APPRAISAL

Practical Illustration in the Determination of Gas Rates.

BY C. L. CORY.

In order to illustrate definitely some of the factors that should be given consideration in the determination of the rates for gas service, I have compiled some data and figures upon a gas plant and system which I will say frankly has no physical existence so far as I know. In other words, while the figures are, I am sure, quite representative of many small gas plants and systems on the Pacific Coast, yet the figures given do not apply exactly to any particular installation..

I can assure you, however, that in general the men who have had experience with such gas service installations may be like the old farmer who was with wonderment and awe seeing a circus for the first time in his life. In the menagerie tent he caught sight of a dromedary. He looked at it a long, long time and finally observed with great positiveness, "There ain't no such animal." And so I will not be surprised if many of you decide in your own minds that "There ain't no such gas company" as the one I have created for the purposes of illustration.

I can assure you, however, that in general the data corresponds to the average small isolated gas plant and system manufacturing its own gas and with the consideration of some of these figures, we may be led to some important conclusions necessarily involved in the equitable determination of reasonable gas rates.

The following data include the important facts pertaining to the gas plant and system used for the purposes of illustration:

Population served	12,000
Cost of oil, per barrel	$0.80
Cost of oil, per year	$14,300
Installed capacity of gas plant, per day	410,000 cu ft.
Installed capacity of gas plant per year	150,000,000 cu. ft.
Total gas manufactured, as measured by station meter, per year	71,000,000 cu. ft.
Cost of oil per 1000 cu. ft., gas manufactured	$0.205
Gallons of oil used per 1000 cu.ft. of gas manufactured	10.65 gals.
Total gas delivered to customers' meters or sold, per year	60,000,000 cu. ft.
Cost of oil per 1000 cu. ft. of gas sold	$0.238
Difference between quantity of gas manufactured and sold	11,000,000 cu. ft.
Per cent difference between gas manufactured and gas sold	15.5%
Aggregate length of distribution sytesm or mains in miles	37.5
Average cost-distribution system or mains per mile, exclusive of services, meters, etc.	$3,335
Number of customers	2,800
Number of customers per mile of mains	75
Total valuation of system	$362,500

In the consideration of the economics of electric light and power installations and service, it is quite usual to determine the investment or value of the plant per unit of capacity or per unit of output. While this is done less often in the gas business, it is interesting to contrast the unit investment required in a gas manufacturing plant and system based on the installed capacity, the quantity of gas manufactured and delivered to the holders and the amount of gas delivered to customers' meters.

TABLE I.

Investment in gas manufacturing plant including holders, distribution system and services, meters, etc., per installed capacity—per 1000 cubic feet of gas manufactured, and per 1000 cubic feet of gas sold.

		Investment per 1000 Cu. Ft.		
Portion of System—	Investm't.	Installed Capacity	Gas M'f'd.	Gas Sold
Gas Manufacturing Plant	$195,000	$1.30	$2.75	$3.25
Distribution System	125,000	.83	1.76	2.09
Services, Meters, etc.	42,500	.28	.60	.17
Total	$362,500	$2.41	$5.11	$6.05

Table I gives this information for the plant under consideration which it is assumed has a total value including the physical plant and also the value of the company as a going concern, amounting in the aggregate to $362,500. This total is subdivided as indicated, the gas manufacturing plant representing $195,000; the distribution system exclusive of customers' services $125,000, and finally customers' services, meters, etc., being $42,500.

In this installation the investment per thousand cubic feet of the plant capacity is $2.41, while the corresponding investment per thousand cubic feet

manufactured is $5.11, and per thousand cubic feet of gas sold, $6.05.

I have used the word investment in the above statement as synonymous with, and the same as, value, which includes not only the physical plant, or possibly the cost of reproduction new but also the going value due to the established business of the company.

Table II sets forth in detail the total annual generating costs and the cost of manufacturing per thousand cubic feet of gas sold. The different items, which are

TABLE II.

Annual Generating Costs and Cost of Generation per 1000 Cubic Feet of Gas Sold.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$15,600	$0.260
Taxes	Based upon gross receipts	1,245	.021
Depreciation	Av. on depreciable portion—5 per ct.	5,350	.089
Oil		14,300	.238
Station wages, maintenance, operation and station supplies		10,150	.169
Total		$46,645	$0.778

included in the total annual operating costs of $46,645, include the rate of return of 8 per cent upon the investment or total value of the plant, the taxes based upon 4 per cent of the gross receipts in accordance with the California tax law, depreciation only on the depreciable part of the manufacturing plant, not including real estate for instance, the necessary fuel oil and finally station wages, maintenance, operation and station supplies.

Table III gives the corresponding figures for the total annual cost of distribution as well as the cost of distribution per thousand cubic feet of gas sold and delivered to customers.

TABLE III.

Annual distribution (not including services, meters, etc.), charges and cost per 1000 cubic feet of gas sold, and delivered to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$10,000	$0.167
Taxes	Based upon gross receipts	800	.013
Depreciation	Av. on depreciable portion—3 per ct.	3,250	.054
Maintenance and operation		5,900	.098
Total		$19,950	$0.332

Table IV contains similar items entering into the total annual cost of serving, metering, billing, and collecting, which naturally include office expenses, as

TABLE IV.

Annual service, metering, billing and collecting, etc., charges and cost per 1000 cubic feet of gas sold to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$ 3,400	$0.057
Taxes	Based upon gross receipts	400	.007
Depreciation	Av. on depreciable portion—4 per ct.	1,750	.029
Salaries, wages, office expense, etc.		12,000	.200
Total		$17,550	$0.293

well as the cost of these items per thousand cubic feet of gas sold.

Table V is a summary of Tables II, III and IV, and while there are many valuable points to discuss

TABLE V.

Total Cost of Gas Services per 1000 Cubic Feet of Gas Sold, and Delivered to Customers.

Item—	Yearly Total	Per 1000 Cu. Ft.
Generation	$46,645	$0.778
Distribution	19,950	.332
Service, Metering, etc.	17,550	.293
Total	$84,145	$1.403

in each of these three tables, I will only refer to the summary as indicated in Table V.

The total operating expenses added to the amount necessary to provide a return upon the value of the plant at 8 per cent per annum is $84,145 per year. If not more than 60,000,000 cubic feet of gas can be sold in the district, the necessary average price per thousand cubic feet of gas sold is practically $1.40.

Do not let it be understood, however, that it is proper to conclude that $1.40 per thousand cubic feet is the proper rate, since it may be not only possible but extremely desirable both for the benefit of the company as well as its customers to increase the total gas sales, let us say, about 40 per cent, which would make the total annual amount of gas delivered to customers 84,000,000 cubic feet. If this increased consumption could be attained without materially increasing the investment required, gas could be sold at an average rate of $1.00 per thousand cubic feet resulting in a total annual revenue of $84,000 which is adequate to give the revenue required to provide a proper return upon the value of the plant.

The important point, gentlemen, is this: What principle should be our guide in the establishment of a gas rate? Attempt to maintain a rate as high as $1.40 per thousand cubic feet, probably thereby reducing the total annual aggregate sales, or make every consistent, reasonable, yes, even possible effort, within the limits of good business policy to increase the sales of gas to as much as 84,000,000 cubic feet per year and adopt a dollar rate per thousand cubic feet. You, gentlemen, are much more capable than any one else in giving the proper answer to this most vital question.

(To be continued)

AUTOMOBILE HORSEPOWER DETERMINATION.

A parliamentary committee recently appointed in England to consider amendments to the present method of determining the horsepower of automobiles for taxation purposes has reported and recommends few changes. The committee considered that the proper basis for rating should be the average power which the engine of a car could develop in regular use on the roads if there were no restrictions in speed other than those imposed by the car itself.

In gasoline and steam cars the present method for determining the horsepower is to divide the piston area in square inches by 2½ for engines of single-acting cylinders with a single piston, by 1 3-5 for single-acting cylinders having two pistons; and by 1¼ for double-acting cylinders having a single piston. It was recommended that this formula be left unchanged for gasoline cars. For steam cars, however, it was considered that the rating should be determined on the basis of the effective heating surface of the boiler rather than the dimensions of the engine, and that this heating surface should be taken to be the whole of the surface in the case of horizontal tubes and half the surface in the case of vertical tubes. The proposed rate is 1 horsepower for every 3 sq. ft.

For electric cars the present regulations prescribe that all motors shall be considered as developing 12 to 15 horsepower, and the committee recommends that this be lowered to 6½ to 12 horsepower.

ELECTRICAL PUMPING AND IRRIGATION

FLOW OF WATER IN CANALS.

BY B. A. ETCHEVERRY.

The coefficient C_1 in Chezy's formula as already developed in this series depends on form of cross section, on roughness of channel and very slightly on the grade. The formula most generally used to obtain this coefficient is Kutter's formula:

$$C_1 = \frac{\frac{1.811}{n} + 41.65 + \frac{.00281}{s}}{1 + \frac{n}{\sqrt{r}}\left(41.65 + \frac{.00281}{s}\right)}$$

n is the coefficient of roughness. The values of this coefficient as determined by experiments by Canguillet and Kutter, by Fortier and by others, are:

$n = .010$ for a lining of pure cement plaster, planed timber, glazed surface in perfect order.

$n = .012$ for wooden pipe, unplaned timber in good order, clean iron and steel surfaces, smooth plaster of sand and cement, concrete lining applied with metal forms.

$n = .014$ for brickwork, well dressed stone work, iron, ordinary concrete lining applied with dressed lumber.

$n = .016$ for riveted steel pipe.

$n = .0175$ for canals in earth in excellent condition, well coated with sediment, regular in cross section and free from vegetation, loose pebbles and cobble rock.

$n = .020$ for canals in earth in good condition lined with well-packed gravel partly covered with sediment with an occasional patch of low water plants, or composed of loose gravel without vegetation.

$n = .0225$ for canals in earth, in fair condition, the wetted surface being lined with sediment, with an occasional patch of minute algae, or composed of loose gravel without vegetation.

$n = .0250$ for canals in earth in average condition having few sharp bends and being fairly uniform in cross-section; the water slopes and bottom being lined with sediment and low water plants, or composed of loose gravel and fragments of rock less than two inches in diameter and free from vegetation.

$n = .0275$ for canals in earth below the average in grade, alignment and cross-section; having indentations on the sides, the edges in places partially filled with earth and gravel and the lining composed of coarse gravel and cobble rock unpacked. This value would also apply to a smooth regular surface if the channel were partially filled with aquatic plants or to a ditch in solid rock excavation with rough faces.

$n = .0300$ for canals in earth in rather bad condition having the bed partially covered with debris; or having comparatively smooth sides and bottom with bunches of grass and weeds projecting into the water or more or less aquatic plants growing in the channel.

$n = .040$ for canals in earth whose channels are about half full of aquatic vegetation.

$n = .050$ for canals in earth whose channels are about two-thirds full of aquatic vegetation.

A new formula for the velocity of water has been derived by Clarence T. Johnston from a series of investigations conducted by him while State Engineer of Wyoming. From these investigations he found that the value of "n" depended on not only the character of the material, but also on the value of "r" (the hydraulic radius) decreasing with an increase in r. To allow for this he deduced an exponential equation of the form $v = Cr^p s^q$. From his experiments he has found that the value of q was 0.5 and for C and p he obtained the following values:

Table of the values of exponents in the formula for the velocity of flow in ditches and canals.

	C	p
Clean straight ditch in earth or firm gravel, free from vegetable growth, made smooth by use..	59.8	0.76
New ditch in earth, with straight channel	45.5	0.80
Old ditch in earth, with straight channel	42.8	0.83
Old ditch in earth, with crooked channel and some vegetable growth	35.0	0.85
Solid rock excavation, crooked channel, rough face	48.5	0.80
Solid rock excavation, straight channel, rough face	50.5	0.83
New ditch in loose rock, with crooked channel.	41.5	0.80
New ditch in loose rock, with straight channel..	41.5	0.83
Old ditch in loose rock, with crooked channel and some vegetable growth	33.0	0.85

Factors affecting flow in canals.

Chezy's Formula and Kutter's Coefficient Formula, and also Johnston's formula show that the velocity depends on coefficient of roughness, hydraulic radius or form of cross section and slope or grade. For approximate consideration of the effects of these factors on the velocity, the following relation is almost exactly correct: First—The velocity varies with the square root of the grade. For instance, increasing the grade four times (other conditions remaining the same) will double the velocity. Second—The velocity varies inversely with the value of the coefficient of roughness, so that an error in selecting the correct value of this coefficient will produce an error of the same proportionate amount, but in the opposite direction; for instance, if the velocity corresponding to $n = .025$ is 2 ft. per second, the velocity for $n = .020$ will be 2.50 ft. per second. To facilitate the solution of problems, in which these formulas enter, diagrams are used which eliminate the lengthy computations.

Relation between factors.

In irrigation problems the required carrying capacity is known; it is determined from the duty and from area irrigated. The other factor which is also generally known is either the grade or the velocity. The factor "n" must be selected according to material. The following cases generally arise:

1st Case: Known, the required capacity and the grade; find the suitable velocity. In the form of cross section (proportion of bed width to depth and side slopes) is fixed, then the velocity can be found by Kutter's formula or diagrams and this determines the area of the cross section. If the form of the cross section is not fixed, then the velocity can vary between limits, but for every velocity there is a fixed form of cross section. The maximum velocity is obtained with the section offering the least wetted perimeter or greatest hydraulic radius. The range of velocities is usually small.

2d Case: Known, the required capacity and the desired velocity; find the grade. Before the grade can be found the form of cross section must be fixed. The section having the greatest hydraulic radius will require the flattest grade. The range of grades is usually small.

Velocities of canal.

The velocity of water in canal must not exceed a certain value or maximum velocity beyond which it would erode the beds and endanger bridges, drops and other works. The velocity must be large enough to prevent the growth of plants and also to prevent the deposition of silt in the canals. The velocity in the main canal must not be larger but preferably smaller than the velocity in the laterals so that the silt will not be deposited before reaching the irrigable lands. In America a velocity of 2 to 3½ ft. is required to prevent the growth of weeds. It is better to give too great than too small a velocity, as in the former case measures can be adopted to protect the channel or falls can be introduced. In the latter case the deposition of silt may be serious and necessitate annual clearance at great expense.

The maximum velocity depends on the erosive power which is the power of overcoming cohesion which varies mainly with the texture of the soil and the size of particles. The erosive power of water varies as the square of the velocity. Safe values are given in the following table. The bottom velocity is assumed to be equal to 75 per cent of the mean velocity.

Table showing safe average and bottom velocities.

	V_a (Av. vel.)	V_b (bottom) = .75V_a
In very fine sandy soil or loose silt	.50	.375
In pure sand	1.00	.75
Light sandy soil, 15% clay	1.20	.9
Light sandy loam, 40% clay	1.80—2.00	1.325—1.5
In coarse sand	1.5 —2.0	1.12 —1.5
Loose gravelly soil	2.50	1.875
Ordinary loam	2.50	1.875
Ordinary firm soil or loam, 65% clay	3.00	2.25
Stiff clay loam	4.00	3.00
Firm gravelly clay soil	5.00—7.00	3.75 —5.25
In stiff clay	6.00	4.50
In conglomerates, soft slate	6.50	4.875
In stratified rocks	8.00	6.00
In small boulders	8.00—15.00	6.00—11.25
Hard rock	13.33	10.00
Concrete	15.00—20.00	11.25—15

The values given for concrete are safe for water carrying small amounts of silt or fine sand; where the water carries coarse sand, the bottom velocity should probably not exceed 8 ft. per second, while for clear water there is practically no definite limit for the maximum velocity. A. P. Davis, Chief Engineer of the U. S. Reclamation Service, in a paper on Safe Velocities of Water on Concrete) Engineering News, Jan. 4, 1912) mentions the following illustrations of high velocities safely resisted by concrete: First—A velocity of 40 ft. per second and more for a spillway chute on the Strawberry Valley project, Utah. Second—A velocity in excess of 20 ft. per second on the South Canal in Uncompahgree Valley, Colorado. Third—Velocities estimated at 75 to 90 ft. for a period of six months, in a culvert through the Pathfinder reservoir. The beds of rivers protected by aquatic plants, however, bear higher velocities than this table would assign, up to 2 ft. per second.

The minimum velocity is dependent on transporting power. From a large number of experiments it has been found that the diameter of bodies which can be moved by the pressure of a current varies as the square of the velocity or that the weight varies as the sixth power of the velocity. This law is only good with stones of the same shape and is only approximately correct. The minimum velocity to prevent the deposition of silt has been variously estimated at from ½ foot per second to two feet or more per second. For waters carrying fine silt the minimum velocity should probably be not less than 1 foot per second and for waters carrying sand not less than 2 feet per second, and preferably mean velocities of 2.5 to 3.5 feet per second should be used. The deposition of silt is more liable to occur where there is a sudden change in velocity. R. G. Kennedy, after many experiments made on irrigation canals in India, found that to prevent silting the mean velocity and the depth of water were related and that the mean velocity should not be less than that obtained by the following equation: $v = 0.84\, d^{.64}$. The equation refers to silt or sand in suspension and not to the coarser sand which is rolled along the bed of the canal and which is more often the cause of the most trouble. Merriman gives the following values for the velocities required to move different materials:

	Bottom velocity.	Mean velocity.
For Clay	0.25 feet per sec.	0.33 feet per sec.
Loam or earth	0.50 " " "	0.67 " " "
Sand	1.00 " " "	1.33 " " "
Gravel	2.00 " " "	2.67 " " "
Pebbles, 1 inch in size.	3.00 " " "	4.00 " " "
Spalls and stones...	4.00 " " "	5.33 " " "
Large stones	6.00 " " "	8.00 " " "

Canal cross section having most advantageous hydraulic elements.

1st. General case, applicable to all side slopes.

The problem of finding the form of cross section which will have the greatest carrying capacity for a given cross sectional area and for a given side slope is

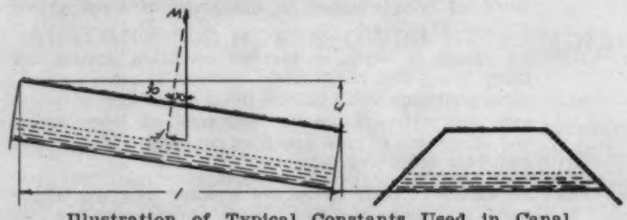
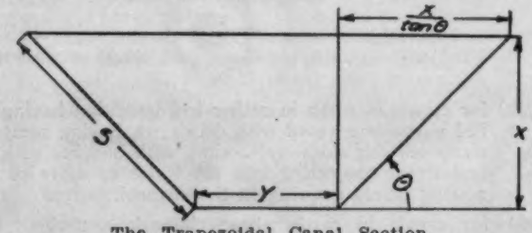


Illustration of Typical Constants Used in Canal Design.

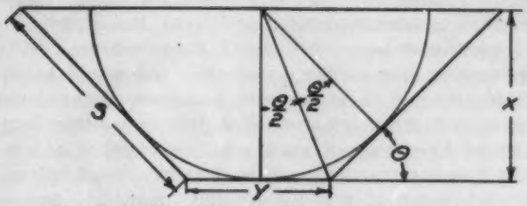


The Trapezoidal Canal Section.

the same as finding the cross section which has the smallest wetted perimeter. The problem may be solved by first obtaining an equation for the perimeter (p) in terms of the area (A), the side slope angle (θ) and the depth of water (x); and then take the first derivative of the equation for p and find the value x, then of y, which give the minumum value of p.

$$x = \sqrt{\frac{A \sin \theta}{2 - \cos \theta}} \cdot y = 2x \tan \frac{\theta}{2}$$

The following graphical method however will be found more convenient to determine the proportions



Standard Notation for Trapezoidal Canal.

of the cross section having the most advantageous hydraulic elements. Describe a circle having its center in the water surface; draw the sides of the desired slope and tangent to the semi-circle, and draw the bottom tangent to the lower point of the point of the circle . The section thus obtained gives the same relation between y and x as expressed in the equation $y = 2x \tan \theta/2$.

2d. Special case. Best side slope for most advantageous cross section. The problem is to find which side slope or which value of θ will give the best one of the advantageous sections. To find this value of θ first obtain an equation for the hydraulic radius of a most advantageous section in terms of θ and A. Take derivative of r in terms of θ, from which $\cos \theta = \frac{1}{2}$, and $\theta = 60$ degrees.

The dimensions of cross sections proportioned to give best hydraulic elements are given in the following table, for various side slopes, in terms of the desired cross sectional area.

Side slope.	Slope Angle.	Depth,	Bottom width.	Width at Water surface.	Length of slope.	Wetted perimeter.	Suitable for
Vertical	90° 00′	.707√a	1.414√a	1.414√a	.707√a	2.828√a	Flumes
1 on 1¼	60° 15′	.760√a	.882√a	1.750√a	.875√a	2.633√a	Rock
1 on 1	45° 00′	.740√a	.613√a	2.093√a	1.045√a	2.705√a	Firm clay
1¼ on 1	38° 40′	.716√a	.503√a	2.293√a	1.146√a	2.795√a	Firm clay
1½ on 1	33° 41′	.689√a	.418√a	2.485√a	1.243√a	2.904√a	Coarse gravel
2 on 1	26° 34′	.636√a	.300√a	2.844√a	1.422√a	3.144√a	Loose earth
Semi-circular		.798√a		1.596√a		1.773√a	Flumes

ELECTRICAL ILLUMINATION AT VANCOUVER.

The recent visit of His Royal Highness, the Duke of Connaught, Governor-General of Canada and his party to Vancouver and Victoria, B. C., was the occasion of great celebrations in which electrical illuminations played a prominent part. The most important illumination in Vancouver was that given at the new office building of the B. C. Electric Railway Company at Carrall and Hastings streets, in the center of the city, a view of which is given in connection with this article.

Illumination of B. C. Electrical Company's Building.

In carrying out this lighting scheme over 5000 lamps were used. The general plan followed was an outlining of the building, as indicated by the view, with a cascade of three rows of lights from the flag-staff to the roof. For the outline strings, 4 candlepower lamps were used and the effectiveness of the display was greatly increased by the row of 40 watt tungsten lamps, located under the coping of the cornice of the upper story, these forming a part of the permanent wiring system of the building. On the ground floor the building was surrounded by a row of 12 regenerative flame arcs placed between each of the arches on the street frontages. On the Hastings street side a special design of a crown in which 200 lamps were used, some being in color, and "God Save the King" in letters two feet high, made an effective addition to the display.

PROGRESS.

"About forty chandeliers in shape like a crown, hung from the ceiling, each carrying thirty-six wax candles. On the King's appearance, all these candles were suddenly lighted and everyone was filled with astonishment at the wonderful and unexpected illumination. Little cords of cotton wool, almost imperceptible to the eye, saturated with sulphur and saltpeter with spirits of wine and other ingredients had been prepared and arranged to carry the flame rapidly from one candle to another. Hardly a candle failed to take fire."—A description of the Coronation of King George II, in 1727, by Cesar de Laussure.

A man stood on the crest of Mt. Wilson. He shaded his eye with his hand and looked far over the plains and the cities to the ocean. The round disc of the sun was sinking rapidly into the deep, and its sheen turned the placid waters and the foam-flecked beach into a blood-red globe. The red ball poised for a moment on the expanse of waters and then plunged beneath the tide. As if by a miracle, the cities of Los Angeles, Pomona, Santa Ana, and as far as the eye could reach to the eastward; to the westward, the shore cities of Long Beach, San Pedro, Santa Monica, Venice, Ocean Park and Redondo all burst into a gleam of artificial light, for such is the world's progress. What is progress? A few giant minds which focused on a great thought brings it into being; a few erratic minds that stumbling over the things of nature, discover its wondrous secrets, and the myriad smiths, who pounding on their little forges, are hammering out the great destinies of the world. Pound well, ye little smiths at your little anvils, for it is you who are forging the progress of the race.—Chas. H. Peirson in Edison Current Topics.

LEGISLATION VS. REGULATION IN ELECTRICAL DISTRIBUTION.

Discussion of paper by J. E. Macdonald, presented before the Los Angeles Section of the American Institute of Electrical Engineers, October 29, 1912, and published in these columns on November 2, 1912.

Geo. A. Damon (chairman)—We have started off this year in a very appropriate manner. In listening to this paper, it has occurred to me that many more of our meetings should be given over to the discussion of vital problems, such as our engineers are trying to solve from day to day. It is evident that purveyors of public service in California are engaged in great undertakings, not the least of which is their effort to obey the mandates of different state and municipal authorities. Our secretary, Mr. Northmore, has agreed to open the discussion of this paper.

E. R. Northmore: First, I want it distinctly understood that I am not opposed to Chapter 499 or Chapter 500, regulating overhead and underground construction, nor am I opposed to any law which makes overhead or underground construction safer and less hazardous. Anyone who has participated in electrical work for the past 15 years and has seen and investigated numerous electrical accidents, will welcome any law that will increase the factor of safety and offers the chance of saving one lineman's life.

There are some of the paragraphs in Chapter 499 which are not clear and which, in my mind, conflict, and I would like to see these conflicting points cleared up so that they could be interpreted in an intelligent manner, so that we could go ahead and construct our lines without danger of having to reconstruct them again owing to a different interpretation of the law by some other lawyer or judge. If the law could be amended, or better still, if the law was repealed, and the entire jurisdiction of line construction placed under the State Railroad Commission, I believe that all parties would be better off and that the line construction of this State would, in a few years, be the best of any in the United States, for, with a body of practical engineers to whom to appeal and explain matters, there is no reason why the companies and everybody interested could not do construction work which would be safe and sane and, at the same time, not work a hardship upon anyone.

Section (1) Paragraph (c) is the one which gives the most trouble and which is the hardest to interpret. The first part, which provides for a clearance of 4 ft. between wires of less than 600 volts and wires of over 600 volts, is all right and should be lived up to, except in buck arm construction. I believe that buck arms should be allowed to be placed 2 ft. below the line arms, and low voltage wires be allowed to be maintained within 2 ft. of high voltage wires where attached to buck arms. This would clear up one of the worst features. It is almost impossible to construct a combination line and attempt to buck-arm from a main line with secondaries of 500 volts power wires, as it is necessary to place our line arms 8 ft. apart, ond on streets where there are three lighting companies and two telephone companies this clearance cannot be obtained.

This clause also provides that combination companies may place their arms 3 ft. apart and maintain high voltage wires 3 ft. from low voltage in a horizontal position. This makes bad constructon. The specifications say the arms shall be 3 ft. apart, which actually makes them 41 in. from center to center. Consequently it would be better for the companies to place their arms 48 in. apart, as this extra 7 in. saved does not give any more space on the poles, and by placing arms 3 ft. apart it makes construction much more expensive and not as safe, as the law says that in this style of construction all high voltage wires shall be on one side of the pole and the low voltage on the other.

I have in mind a line which we are now rebuilding, where we have nine No. 00 2200 volt wires, fifteen arc wires and two 500 volt power wires. If we had placed our crossarms 41 in. from center to center and used the standard 8-pin arms, we would have used six 9 ft. crossarms, with four wires on each arm on the street side, and would have used something over 20 ft. of the pole, and with another company under us with three arms of wires, this impossible construction would have been a good example of what a law controlling line construction without detailed specifications covering each point of the construction work is. Instead of constructing this particular line in this manner, we simply placed our line arms 2 ft. apart and filled three of them with high tension wires, arcs and primaries, and then placed an arm 4 ft. below and placed the 500 volt power wires on this arm. The next company coming on our pole will go 4 ft. below this arm with its lines; but, are we living up to the law?

Another question is this: Suppose two companies should build a line according to these specifications; that is, place their arms 36 in. apart, and later on one company should purchase the interest of the other company, would it be necessary for the company to reconstruct this line and put its arms 4 ft. apart? For this reason, I do not believe it is practical for any of the companies to attempt to build their lines according to this part of paragraph (c), which allows the arms to be placed 3 ft. apart, but that the companies should build as though one company only were on the poles; that is, at all times, maintain their low voltage wires 4 ft. from high voltage.

I would like to ask Mr. Macdonald to clear up some of the disputed points in Section (1), Paragraph (c).

With two distributing companies on one pole, if we keep our low voltage wires 4 ft. from the high voltage wires, is it necessary to keep the high voltage wires on one side of the pole only?

With high voltage wires 4 ft. from the low voltage wires, can we place our arms, which have only high voltage wires on them, 2 ft. apart, just so the low voltage wire is put on the arm which is 4 ft. from the high voltage wires? In other words, in combination work, if we keep our high voltage wires 4 ft. from our low voltage wires, as provided for in the first part of paragraph (c), cannot we build and maintain our combination lines with the same construction as provided for in the first part of this paragraph? Does the 36 in. provision, and the provision for high voltage wires to be on one side of the pole, only apply when arms are put on the pole less than 4 ft. apart?

What is meant by a distributing company in this paragraph (c)? Would a lighting company's high line, or a railway company's high line be classed as a distributing line on a combination pole, if the company who owns the high line had no other wires, than the high line wires on the pole? Take for instance where one distributing company has a high line on top of a line of combination poles, and a second distributing company makes combination on those poles, would it be necessary for this second company to place all its high voltage wires on one side of the poles, and all its low voltage wires on the other side of the poles? If that is the case, would not the distributing company who owns the high line be compelled to place its entire high line on one side of the poles also?

In conclusion, Mr. Macdonald states that our cost of construction has been increased ten per cent. I think twenty-five per cent would come nearer to it. It does seem too bad that we have to reconstruct all our line work during the next four years, when, within the last five years, the Joint Pole Committee of the City of Los Angeles has reconstructed over half the line work of this city on joint poles. They have done the construction work according to the National Electric Light Association specifications and have removed about 30,000 poles. In fact, I do not believe this law should be retro-active but should apply only to new work. And, I be-

lieve, the utility companies are going to have hard work in getting different public utility boards to allow a rate which will pay for the additional expense in tearing down good line construction and putting it up again. I have made a rough estimate of the cost of reconstructing, and am sure that Mr. Macdonald's estimate of half a million dollars for reconstructing this city is not too large, and this means that at least $250,000 of the money is to be spent for reconstructing work which has been put in within the last five years, and which is now up to the specifications of the National Electric Light Association on joint pole work.

The Chairman: We shall probably expedite matters if we proceed with the discussion, and Mr. Macdonald will be given an opportunity to close the discussion and answer all questions. We would be very glad to hear from Mr. Cunningham.

R. E. Cunningham: Mr. Macdonald in his paper has referred to paragraph (c) in regard to the color to be used in painting crossarms which carry high voltage wires. Most of the light and power companies in Southern California have adopted the general practice of painting crossarms standard green color and made use of the alternative given by the law, of installing on these crossarms the enameled iron "High Voltage" sign rather than the use of crossarms painted yellow. It was believed that the general use of yellow crossarms on the streets and highways of the country would meet with the disapproval of the general public as it makes the pole lines very noticeable, whereas the green cross arms tend to blend with the surrounding landscape and certainly produces a much more pleasing effect. There has been one case, however, where the Southern California Edison Company has found, after a year's trial, that the enamelled iron signs are not satisfactory. This condition exists where lines are installed along the beach in a very foggy district. The signs were practically destroyed within a year, due to the action of the salt fog. In this particular case it will be necessary to make use of crossarms painted yellow and to break the standard which has been adopted.

If these matters were regulated by a State Commission rather than fixed by legislation, there is no doubt under the conditions mentioned above, that permission could be obtained for the stenciling of the high voltage sign on a green crossarm as a stencil sign would give satisfactory results. This is only one particular instance which would go to show how much more satisfactory it would be for matters of an engineering nature to be controlled by a commission who could always be called upon to make rulings to cover particular cases. All practical engineers will agree that particular conditions will always arise which will differ from any which have been considered heretofore and will require special consideration and methods. With these matters controlled by a fixed legislation it allows no recourse other than to adhere strictly to the letter of the law.

One further point in regard to this particular paragraph, is the fact that it specifies that all high voltage wires must be installed on yellow arms or arms bearing the high voltage sign. Supposing the yellow sign to have been adopted as standard, there is nothing in the law which would prohibit the placing of low voltage wires on the same color of arm. In fact, when crossarms are sent out from the storeroom and installed on the line it is impossible to state in all cases just which crossarm would be used for supporting high voltage wires and low voltage wires, the result being that a yellow arm could be adopted for supporting wires of all voltages and the real purpose for which the rule is made is not accomplished.

The Chairman: We have with us tonight the representative of the Power Bureau of the city. Will you let us have your views Mr. Scattergood?

E. F. Scattergood: There is good reason for believing this the state law is inadequate as a guide to overhead construction. From the information I have at hand it occurs to me that the law practically compels joint pole construction and yet does not adequately provide for conditions making such construction possible. In matters of this nature it is extremely doubtful if the desired results are to be obtained by legislation. The advance of the electrical art is so rapid and the legislative process is often so slow that it seems right that such matters should be left to a commission with competent engineers to differentiate between what is or is not correct construction. It is probable that certain fundamental principles could with impunity, be enacted into law, but the application of a complex statute can scarcely produce results.

H. B. Lynch: The title of Macdonald's paper "Legislation vs. Regulation in Electrical Distribution" is broad enough for several evenings' discussion, including, as it does, the whole scope of the Public Utilities Act.

We are all in favor of enactments which will form a standard of line construction, and which will conform to good engineering practice and add to the safety of our lines, without making our construction unnecessarily expensive.

Chapter 499 in general does add to the safety of our constructions, but is faulty in several respects.

In going over the law the first point that attracts attention is the 13 in. clearance provision. This might well be made 15 in. for high potential wires, as most companies have voluntarily adopted this clearance.

It is unnecessary to say much about paragraph (c), referring to distances between high and low tension wires, as that has been already covered by those who have spoken.

The section which calls for high voltage signs on crossarms in cities carrying 10,000 volts and over is unnecessary, as the insulators themselves give ample notification of the voltage to all who have any occasion to climb the poles.

Paragraph (h) of Section (1), relating to highway and other crossings of high tension lines is entirely too drastic, as it practically requires that all high tension lines be strung with No. 0000 wire. In a recent instance where a few miles of high tension line was contemplated by us, this provision would have added fully $10,000 to the cost of the line, above what good engineering practice and a proper regard for safety required.

F. B. Lewis: Mr. Macdonald has fully pointed out the various clauses which go to make up Chapter 499, Statutes of California, 1911. Owing to the ambiguity of this law and the numerous interpretations which might be obtained therefrom, it is my opinion that it should be either redrafted or repealed at an early date.

I believe that all operating companies will bear me out when I state that proper regulation is to be desired, and also that better results will be obtained from regulation rather than legislation. Proper regulation will produce standardization, which in turn stands for efficiency and economy. We are all striving toward standardization and probably no one thing will bring about a general standardization amongst all operating companies as quickly as proper regulation.

There has recently been passed by the city council of Los Angeles Ordinance No. 26092 which makes necessary certain undesirable construction; as, for instance, the use of guy stubs instead of anchors. As near as I can determine this ordinance was passed by the council without referring the same to the Board of Public Utilities, and I simply mention it to emphasize what I have stated above, that better results will be brought about when we have regulation by skilled technical bodies rather than legislation.

No matter how conscientious legislative bodies may be, it is not to be anticipated that they should possess the technical knowledge which comes only with many years of practical experience along the special lines under consideration.

T. A. Panter: I am not in such close contact with the subject under discussion as a number of the gentlemen pres-

ent, but I believe Mr. Macdonald has covered the ground very thoroughly in his paper this evening. It seems to me that if it is impossible for those who are in such close contact with the work to understand the meanings of the various sections of the acts as passed, and who are continually in touch with these problems and endeavoring to solve them, it is going to be far more difficult for the rest of us to understand their meaning.

I believe that a solution of the problem would be to have a representative, or representatives, from engineering departments of corporations and municipalities, and other engineers in the State, get together and draft a set of specifications or rules which would remove the objectionable features, making a law or set of laws which would be practicable and not a burden, after which the influence of all parties should be concentrated toward having these matters placed in the hands of a competent board or commission, such as the Railroad Commission, and submit such plans or specifications to that body.

E. Y. Porter: I am very glad to be present this evening, and have had one or two points cleared up for me which I was reluctant to consider as settled from my standpoint. I have been considering myself all kinds of a fool for not being able to secure a satisfactory ruling on Paragraph (c), Section (1). Having relieved myself of this personal stigma, I am willing to go forward to the solution of the real problems of the statute. I certainly agree in the fullest extent to the sentiment which has been repeatedly expressed here tonight, to the effect that it is impracticable to formulate any set of inflexible rules covering practical construction in any art which is constantly changing and progressing, and to incorporate such rules into statute law. I am sure that none of the utilities companies have any desire to evade the law, nor to depart from good practical construction. What we want is not to combat or evade the law, but to know how to comply with it. If, after over a year of study and experimenting, no two engineers can agree in all respects as to what construction is permitted or forbidden by this law, it would certainly seem that either a revised law, or a comprehensive interpretation of the law as it stands by competent authority, is absolutely necessary both to the operating companies and for the safety of the public.

If we could have some competent authority to whom disputed or ambiguous points of the law could be submitted for interpretation, or, better still, if the present law could be repealed, and the whole matter placed in the hands of the Railroad Commission, or similar body, I am confident that it would not take long for the Commission and the engineers of the various companies to get together and formulate specifications, which would not work any hardship upon the utilities companies, and would safeguard their employes more perfectly than can possibly be done under the present state law.

In regard to hanging transformers upon pole lines carrying primary and secondary wires upon the same crossarm, referring to Fig. 3, it will be noted that one wire to the high tension side of the transformer is brought across close to the pole on the under side of the crossarm. This wire is supposed to be heavily insulated. Can we expect that it will always be so insulated? Practically, I think we will find it is usually an ordinary weather-proof wire.

The chief intent of Paragraph (a) of the law is, evidently, to keep the climbing space on the pole as free as possible from high tension wires. It would, therefore, seem preferable to hang the transformer upon crossarms at right angles to the line arm, as shown in the accompanying sketch. This construction, it will be noted, keeps all wires entirely clear of the pole or crossarms, and permits the lower crossarm to be used as a branch line "buck arm," or house service arm. Manifestly, the same construction can be used for hanging two transformers for open delta, three-phase connections.

I believe that the provision requiring crossarms carrying high voltage wires to be painted yellow, or in lieu thereof, to have a high voltage sign attached, does not tend to additional safety, on account of the fact that if the former system, which is undoubtedly the simplest, is followed, there is still nothing to distinguish between high voltage and low voltage wires, which may be carried on the same crossarm, unless half of the arm is painted another color, which would give a grotesque appearance to the line, to say the least.

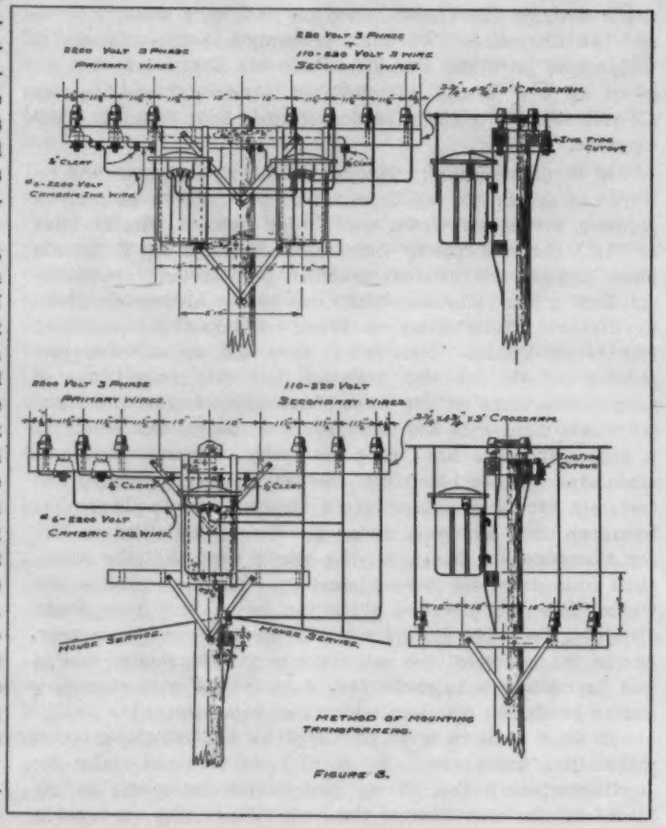

2200 Volt 3 Phase Primary Wires.
220 Volt 3 Phase or 110-220 Volt 3 Wire Secondary Wires.
5' Clear
#6-2200 Volt Cambric Ins. Wire
Ins. Fuse Cutout
2200 Volt 3 Phase Primary Wires.
110-220 Volt Secondary Wires.
House Service.
House Service.
Method of Mounting Transformers.
Figure 3.

Fig. 3.

I understand that some steps have been taken towards securing a revision of the law, and I am sure that it would be of the greatest interest to all present to know just what has been done along this line.

The Chairman: If there is no further discussion, I shall call on Mr. Macdonald to satisfy the inquiries which have been made concerning this law.

R. S. Sorenson: I would like to know who originated this law; who is responsible for this beautiful piece of work?

J. E. Macdonald: Prof. Sorenson's question being the easiest one to answer, I shall endeavor to enlighten him first, although the majority of us know the complete history of these laws.

The overhead and underground laws had their origin in three bills, numbered 312, 313 and 314, which were presented to the state legislature early in 1911, by the labor organizations of San Francisco, where similar legislation had been enforced by ordinance for some years. Bills 312 and 313, by legislative action, became Chapters 499 and 500 of the 1911 Statutes. Bill 314 provided for the creation of an official, to be known as "state electrical inspector," who was to have authority to appoint an indefinite number of deputy inspectors, the latter to act without compensation. This bill was withdrawn in committee. It should be stated further, however, that the labor organizations deserve credit for their part in this legislation. Although the law has been in effect for one year, there has been practically the fullest cooperation on their part, notwithstanding the fact that the

law offers excellent opportunity for coercing refractory corporations to accept the dictation of organized labor. I merely mention this fact because the inquiry has been made, and because this phase of the subject was uppermost in our minds when these companion bills were introduced into the legislature.

In considering this Paragraph (c), the main idea to be kept in mind is the probable intent of the authors of the bill, which was to provide 4 ft. clearance between wires carrying more than 600 volts and wires carrying less than 600 volts. I believe, therefore, that the common sense solution of this paragraph (c), as given by Mr. Northmore, is quite correct; that is, the placing of all primary and street lighting circuits on crossarms, spaced, say 2 ft. apart, with all low voltage wires on crossarms, which must be spaced at least 4 ft. from the primary arms, but not more than the standard spacing of 2 ft. from each other.

I do not believe that Paragraph (c) was intended by the authors to apply to anything but distributing circuits, and any reference to high tension circuits, exceeding, say 6600 volts, should be disregarded, as, at this voltage and above, the standard of construction must necessarily be raised so as to come without the range of specification provided for by Paragraph (c). I do not maintain that this is a legal interpretation, but the section is so ambiguous that a legal decision must necessarily be very remote from solving the problem fully. Until some better solution is offered therefor, I would suggest the adoption of the 4 ft. spacing, between high and low voltage crossarms, which is a more rigid clearance than that providing for joint construction, and should, therefore, not raise any question as to its legality. I would not recommend putting primaries and secondaries on the same crossarm, except where it is necessary to maintain but one arm. The primaries may be bucked in the usual way, directly above or below line arm, and the secondaries should be bucked on separate arm 4 ft. below. Where so much space on pole is not available, it is customary to buck primaries only, and take care of the branch secondaries by an additional transformer. I believe Mr. Northmore is using this method quite extensively.

With reference to Mr. Northmore's inquiries regarding the interpretation of paragraph (c). I do not feel that I am able to clear up this matter to his satisfaction. During the past year he and I have agreed to disagree as to the interpretation of some of the most important points. However, I do not anticipate that he will invite a jail sentence for himself or any other member of his company, by continuing his present method of construction. Not that it is absolutely correct, but it is probably closer to the intent of the law than the law itself. Mr. Northmore's difficulty, and his solution of it, are shown in Fig. 7. In one drawing it will be noted that all arms are 36 in. apart, primaries and high voltage wires all on side of the pole, low voltage on the other. In the other drawing is shown what is considered the correct construction, and complies with the first portion of Paragraph (c), Section (1), but not with the portion providing for joint construction.

It would, indeed, be very interesting to know what the committee, that drafted the National Electric Light Association's specification, would have to say about this law. This specification, which has become a National standard, was gotten up to provide for the severest climatic conditions, much severer than anything in the populated districts of California. It has never been suggested before that large clearances make for maximum safety. There is a certain safe clearance, which it is not reasonable to exceed and, personally, I do not believe the National Electric Light Association's specification is very far from the correct one in this respect.

I have in mind, a corner in this city, where, to reconstruct and comply with the state law, and other proposed regulations, would require space of 56 ft. on pole for wires of two companies only, not allowing for any cross leads. The clearance from top of rails of the railroad, at this point, must be not less than 26 ft. Allowing for 8 ft. length in ground, this would demand a 90 ft. pole. The poles used in this lead as a matter of fact are now 60 ft. poles and the clearances demanded would produce such grotesque construction at corners that some other method—probably underground—would have to be adopted to overcome this condition, the cost of which might be prohibitive.

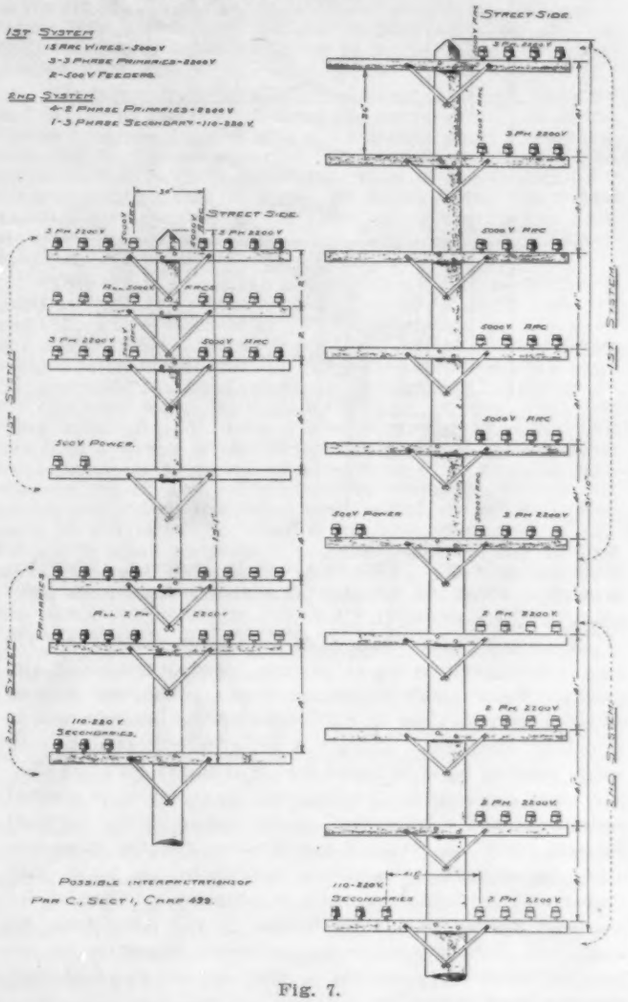


Fig. 7.

I have been much interested in Mr. Porter's remarks, although I do not exactly approve of his method of mounting transformers; that is, on the side of the pole. Mr. Porter's method is shown in Fig. 8. I believe a comparison between this and Fig. 3, will show its disadvantages. When one or two transformers are placed on one side of a pole, it throws a load across the line if pole is not perfectly straight. The pole is also harder to climb and, I believe, there is more danger in connecting a transformer in the manner shown. When we are mounting a transformer in a station, or any inside location for that matter we are very careful to have our wires installed in the neatest manner possible and great care is given to securing the best possible material for making connections. There is no reason why our overhead line construction at vital points should not receive equal if not greater care in its installation. The lead or jumper wires shown in Fig. 3, are of varnished cambric insulation, and are safe for 15,000 volts.

Just one word more, with reference to Mr. Porter's question as to what has been done in regard to securing a revision of the law. We have made what might be called great progress in this direction, in, that all wire using companies in California are practically agreed as to what con-

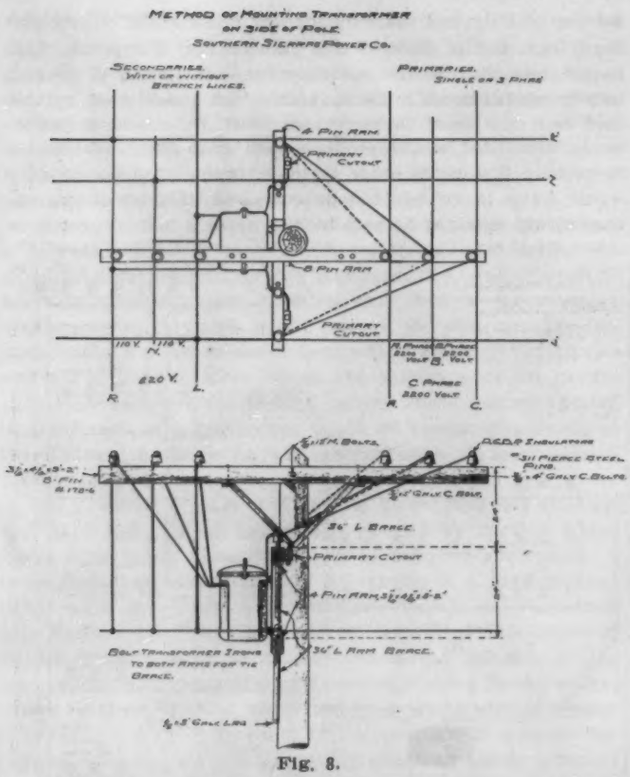


Fig. 8.

stitutes a safe law. This is certainly progress. They are anxious to adopt any rational suggestion looking toward the safety of their employes.

Many good suggestions have been made tonight, but unless such suggestions are acted upon, we shall not obtain any results. Mr. Panter's suggestion that a committee of engineers, in various lines of work, take up the investigation, is valuable. They could prepare a set of specifications which would possibly be even better than that of the National Electric Light Association. I would even go so far as to suggest permitting such a committee, to be limited to the National Electric Light Association's specification, and the state law, using the maximum clearances provided by the latter, with proper modifications, to prepare a complete specification for overhead construction in California. If this were done, we might look back without regret upon the difficulties we are now encountering in seeking to obey the mandates of state and municipal authorities.

B. F. Pearson: A great deal has been said and many criticisms directed at Chapters 499 and 500 of the State Code, yet perhaps if all of the facts were known everyone concerned would feel that at least a tremendous step had been taken in advance of anything prior to said date, which would tend to a united effort (on the part of the utility companies operating in California), for standard construction.

Three elements harmoniously united in effort are absolutely essential in the proper drafting of specifications covering uniform construction of pole lines, underground conduits, and other structures necessary for the transmission of electrical energy in any form: viz., the public, the utility companies, the employe.

Prior to the 1911 session of the California legislature these elements were not united. There were almost as many standards of construction as there were companies; the standards varying with the difference in degree of intelligence, the difference in financial conditions, character of property, etc., and in many instances the standards of construction of individual companies reflected an utter disregard of the public safety, and the life and welfare of the man on the pole, and between a possible united desire for safe construction on the part of the utility companies, and the determined effort on the part of the "man behind the gun" to do something, there was a great gulf fixed. A few feet added to the length of a pole or cross-arm meant to the man on the ground the difference between safety and hazard, and it is conceded that a long time would elapse before all of the companies operating in California would unitedly petition the California legislature to make laws, laying down a standard of construction which would be uniformly satisfactory and safe, and it is not hard to believe that tremendous difficulty would have been involved if the employes, whether represented by organizations or not, had attempted to bring the companies together. They would have met with failure, and I understand that this proposition was given serious consideration by the trades organizations involved, but given up as a hopeless task; hence it devolved on the "knight of the spur and the come-a-long" to get busy. From my intimate knowledge of the circumstances immediately preceding the passage by the 1911 session of the legislature of certain bills governing overhead and underground construction, the sentiment prompting those who drafted (?) the bills and saw them through the legislature and senate was ninety per cent protection to the worker, and ten per cent work for the worker. As one of the labor union proponents, lobbying for the bills, put it, "Hell, what's a few dollars, compared to a few funerals?" It must be admitted that one cannot look on the disfigured features of a fellow employe, after he has been "taken off the line," and perhaps follow him to the "little green meadow," without wishing most fervently, that pole line construction was in every essential respect "safe," and damning, inaudibly at least, every interest which appeared to oppose "safe" construction.

A great many abortive attempts at legislation have been made in California covering this particular question, but unfortunately the attempts were made in the spirit of prejudice, by unwise representatives of trades' organizations, who appeared to be prompted by a sentiment, ninety per cent to "get even" with the companies, and ten per cent something else. Consequently wherever legislation was attempted governing the regulation of line construction, etc., opposition was developed, which all resulted in convincing the worker that if he "got anything" he must do it with the soft pedal on; hence the fact, that the "legislative committee" of the Brotherhood of Electrical Workers, who were responsible for the laws in question, worked secretly, and strange as it may seem, did not extend to the utility companies the courtesy of informing them of their plans, asking their cooperation, or their approval, of the bills before their passage.

It is generally conceded that the 1911 session of the California legislature differed from that of any other preceding it. Business interests had, to a large extent had their day, or sessions, as the case may be. One of the distinguishing characteristics of the 1911 session being, that the hero of overalls and brogans had a "look-in," and they were not slow to take advantage of it; (from all I can gather these men had a perfect right to do this, it appearing on investigation, that they were enfranchised citizens of the commonwealth of California.)

Considering all of the circumstances, it is not to be wondered at that there are a number of points in the law, as it now stands, open to criticism. It may be well to remember, however, that the original bills were hurriedly prepared by a few non-technical electrical workers, and the subject matter whipped into shape by a gentleman who was then the attorney for the Teamster's Union of San Francisco. It is quite likely that he also was non-technical, at least in electrical engineering, and if the law as it now stands is somewhat confusing and conflicting, which is admitted, it is both comprehensive and conservative, and absolutely consistent, compared with the original bills which went to the legislature for their first reading, and which later were amended.

I have been asked to give a brief outline of the situation as I saw it in Sacramento, during the "struggle," and my relations with the Legislative Committee of the Electrical Workers, etc.

My first knowledge that legislation was being attempted was at 2:30 p. m., January 28, 1911, when a file of correspondence was handed me by my company, including drafts of bills Nos. 312, 313 and 314, with instructions to proceed to Sacramento, and do all that I possibly could in preventing unwise legislation; at the same time being given to understand that my employers were heartily in favor of some safe laws governing electrical construction.

After arriving at Sacramento I found the bills had been presented to the legislature, and in turn referred to the Committee on Labor and Capital for discussion, etc. I attended the first meeting. Contrary to expectations I found very few representatives of the power companies present, in fact only two other power interests being present. The proponents of the bills, the Legislative Committee of the International Brotherhood of Electrical Workers, were present to "back" up their demands for legislation. The Committee on Labor and Capital were in sympathy with the proponents; one member of the committee being a lineman; the second member of the committee being an electrical worker of another kind; the chairman of the committee being legal counsel for certain labor organizations affiliated with the International Brotherhood of Electrical Workers. The attitude of the committee, however, was to give everyone an opportunity to express his views. My business was to express my views, and I did so in unmistakable terms, with the result that the Legislative Committee returned to San Francisco at the end of the first week, and reported that they would have to get "that fire-eating blankety-blank from Los Angeles out of the way, if they ever expected to get anywhere."

To cut the matter short; later I made advances to the Legislative Committee, stating to them most clearly that I was there to either defeat the bills entirely, or to assist them in amending them so that they might be at least reasonable in their demands. The result of our conference being that I was later asked by the Legislative Committee of the International Brotherhood of Electrical Workers to act as chairman of the joint conferences which we determined to hold between the committee in question and representatives of power, telephone and telegraph companies, to discuss the amendments which were necessary.

The original bills were, from many standpoints, absolutely objectionable and the proponents of same arrived at this conclusion after many friendly conferences. The time, however, was short. The bills must be amended, and I promised these men in good faith that I would stand with them if they would amend the bills in a way that would not be absolutely arbitrary, and stand I did. The amended bills, however, as finally drafted, still contained much that can be improved upon.

In my letter to Hon. Hiram W. Johnson, Governor, in response to his inquiry, asking me to give him the benefit of my views on the bills in question before they went too far, I stated:

"I am presuming that you do not care to have me go into much detail regarding the matter, and that you wish my opinion from two standpoints, namely, the necessity for bills of this kind, and the scope and character of the bills in question.

"Regarding the first point, I beg to say that unquestionably there is need for proper legislation covering the construction of electric pole lines, used for distributing electric current for power or light, also for pole lines carrying telephone, telegraph or signal wires. At the present time there is no standard for the various interests to work to, with the result that in many instances an almost criminal disregard for the safety of the men who are called to work on pole lines is evidenced; these conditions are very apparent in many of our cities. While the record of accidental deaths from electrocution, and deaths arising from accidents of this character, will show that a large number apparently are purely accidental, it will be found that in many instances a proper regard for the safety of the workmen in the method of construction, would have made the accident improbable, and in some instances, impossible.

"I, therefore, contend that proper legislation is needed for the purpose of adopting a standard of construction for the State of California, which will reduce the hazard to life, be practicable, and lend itself to the necessary improvements in the art of electric lighting, etc.; will also be comprehensive, taking into consideration not only lighting wires, but also the main features of construction for high tension circuits, transmission lines, etc.

"Therefore, from the above standpoint, Assembly Bills 312 and 313, in so far as they cover the points noted, are in the line of progress, but the bills are not sufficiently comprehensive, and do not cover various vital points which should be taken care of in the final consideration of the subject; and I am presuming that at some future date, after the Public Utilities Commission of the State of California has been appointed, and have sufficient time, that they will adopt specifications covering all classes of work.

"This brings me to the consideration of the second viewpoint, namely, the scope and character of Assembly Bills 312 and 313. I have referred above to the fact that the bills were not comprehensive, and were not broad enough in their scope. I would refer, first to Bill 312: It will be noted that while careful provision has been made in Paragraph 'C', relating to the clearance which must be maintained between wires carrying more than 600 volts of electricity, and wires carrying less than 600 volts of electricity, no provision has been made for maintaining a proper space between wires carrying high voltages, which are not assumed in Paragraph 'C', as this relates particularly to lighting wires, which are generally 2000 volts or 440 volts. In other words, the proponents of Bill 312 had in mind, particularly, ordinary congested city lighting wires; whereas, the practice is becoming very common, and is almost necessary, to carry voltages on public highways and along thoroughfares, which are in many instances congested residence thoroughfares, up to 15,000 volts, and sometimes higher. It would seem, reasonable, therefor, that the clearance to be maintained between the 15,000 volt wire and the 2000 volt wire is just as important, in fact more so, than the clearance to be maintained between a 2000 volt wire and a 440 volt wire. In all of our construction we maintain a distance of five feet between the high voltage wires referred to, and the low voltage wires of 2000 volts referred to." Etc., Etc.

I am not including my entire letter in answer to the Governor, as it contains much that is of no particular importance at this time. It will be seen, however, that under the circumstances, the best was done that could be done, and it is my opinion that more was accomplished, during the period of the three weeks that the writer was in Sacramento working on this matter, to bring about a better understanding as to the relations which should exist between utility companies and the employes, than had been accomplished for a long time previous, and notwithstanding that the writer is known to the representatives of the International Brotherhood of Electrical Workers as being an "open-shop" advocate, by letters received from him, the fact is very evident that personally they held me in some esteem, for what they are pleased to call a "square-deal," and the further fact that when I had the opportunity, I did not double-cross them. And all that is needed, in my judgment, now, to either amend present laws, or make new ones which will be entirely satisfactory to the public utility companies and the employee, is cooperation, undertaken in the spirit of real tolerance, and the spirit of mutual interest. We have had legislation; let us have cooperation, and by all means, let the man who works, and who hazards his life daily, be given an opportunity to express his views, and have them, as far as they are practicable, incorporated in said laws.

I wish to add further, that after meeting and becoming acquainted with the executive officers and the legislative committee of the trades organizations of Northern California, who were present at Sacramento, I found them to be tolerant, square, generous and gentlemanly. Let us have cooperation.

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Talking in the Other Man's Talk

In Holy writ it is recorded that the greatest engineering task in the early dawn of history was interrupted and absolutely abandoned, due to a confusion of tongues. Many a modern tower of Babel is, for similar reasons, either hindered in its growth or actually deserted before the completed engineering triumph can be made of maximum use to man. Instances by the hundreds may be found in central station practice. The sales engineer, who goes out to sell his product upon the farm, imbued with the importance of high sounding technical terms, may occasionally knock his victim down with the butt end of his pistol. Only seldom, however, does he attain the permanent results desired. In the engineer's mind a clear mental vision may exist of the financial gain that will result to the farmer should he purchase power for pumping purposes at three cents a kilowatt hour. What a mental picture must be drawn in the farmer's mind, however, after an hour's harangue on power for pumping purposes at three cents a kilowatt-amperes and volts! Shades of droughts and deserted haystacks! No wonder as the time for the supreme decision arrives the farmer glares at the sales engineer with that far-distant perplexed expression which seems to say: "Well, I understand you are working upon a new puzzle, but—what's the answer?"

Talk to him in his own everyday talk and how different! The farmer has in his tract a certain definite number of acres. He knows that the return per acre is the unit upon which his income must be made. It is immaterial to him at what particular price per kilowatt-hour the power company can sell their product, so long as his purchasing the same will bring a greater return per acre than without its use. He knows to a dot what it costs him per acre to plow, to seed, to mature, and to harvest. He is familiar with general market prices of this product. Unless, now, he can be approached in a way that he can figure that the central station proposes to furnish power for irrigation at so much per acre per year, he is all at sea. To make a successful campaign in an agricultural community, the central station sales force must be ready to meet this emergency. In the early introductory stages it is better to sell power directly in a manner which appeals to the farmer according to his process of reasoning. An up-to-date sales-force should be so technically versed that selling power on this basis—a rate that talks to the farmer in his talk—should involve no more uncertainty to the central station than the kilowatt-hour basis. At least, it must be admitted that it involves far less risk to the central station, rich in experience from other communities, than to the farmer who is wholly at loss to judge and must take the word of the central as an assurance for the correctness of the prophesied results. Bread thus cast upon the waters will be repaid in a ten-fold measure. Recall to mind the limits to which the Northern Colorado Power Company has gone in this matter. This company has met with unprecedented success from its liberal policy. It not only sells power at so much per acre irrigated

per year but actually finds it profitable to finance the well-sinking and even guarantee water-striking or no cost to the farmer. Central stations now driving their energetic campaigns in fertile Western valleys will do well to heed the broad policy of assisting the farmer in every reasonable manner possible. They should aid him to make a return on his holdings, even though such assistance does involve at times a material risk. And, above all, in putting an electrical proposition to one versed in agricultural pursuits only talk in the talk used in the daily routine on the farm.

The instance cited above applies to every class of power consumer. Too often the lumberman familiar in units of cost per thousand feet of product, turns down the power salesman simply because he does not care to confess his ignorance of electrical terms. Unconvinced, though the proposition be fundamentally sound, he stays by his first love—the steam engine. Countless other instances may be cited among the possible electric power consumers of our great cities. The most fruitful field—that of the near consumer—as a rule, is the most ignorant of electrical terms.

Money talks—so does the salesman. If the central station desires to receive this pecuniary talk of the possible consumer, a talk befitting the range of mental vision of this consumer is absolutely imperative.

Some engineers believe in foreordination instead or coordination. Their belief is reflected in their works.

Coordination and not Foreordination

Possessing highly perfected mental analysis for one class of design, they presume all knowledge. They assume a foreknowing of all events of every class. This is a belief in foreordination, for according to the Standard Dictionary, foreordination is an act of the infinitely intelligent, foreknowing, righteous and benevolent will of God from all eternity determining the certain futurition of all events of every class whatsoever that come to pass.

In the symphony of harmonious design, would it not be better for the engineer, endeavoring to render a perfect composition, to press lightly on the soft pedal when bringing out a melody of a somewhat unfamiliar nature, and thus allow his fellow musisicians a fuller opporunity to join in the harmony hoped for? What a salient blessing it would be, if, now that the period of second thought in engineering design, has arrived, coordination of results accomplished could in the future be the ruling passion. The engineering installations of the West stand as monuments of achievement. It is a striking characteristic, however, that in each plant is brought out or emphasized some particular feature which stands head and shoulders above the other parts of the installation. The power plant of the future should combine all of these splendid special features invented by the genius of half a hundred engineers. No one detail should predominate, or be unduly emphasized. The story of the weakest link as being the test of strength for the chain is indeed applicable to the power plant.

Hence, although unduly emphasizing certain links in the power plant layout at times brings an individual halo over the installation, yet to bring up to to standard the weak features in design there to be found makes as a whole an engineering creation far more harmonious and effective.

Oregon has through its voters enacted at the recent election the socalled Malarkey public utilities act,

The Malarkey Commission

whereby the railroad commission of that state is given jurisdiction over the public utilities. The new bill requires adequate service and reasonable rates, common using of certain facilities and compensation therefor, valuation of properties, uniform accounting and reports.

The enactment, while largely copied after the Wisconsin Commission law, does not contain the indeterminate franchise provision. This omission may prove the better part of judgment. A recent decision of the circuit court of Dane County, Wisconsin, holds, in what is known as the Appleton waterworks case, that in fixing the price which a city is to pay for the purchasing of a utility, the Railroad Commission must add a value for the indeterminate franchise. Most recent evolution in utility appraisal practically is unanimous that a franchise for which nothing is paid has no value for rate fixing purposes. If the principle upheld in the above mentioned Wisconsin circuit court stands the supreme test, the value of the indeterminate franchise theory may be materially impaired.

The review feature is also missing from the Oregon law. In California a review of the commission's decisions may be taken directly to the state supreme court, without the delay and uncertainty attendant upon a retrial in inferior courts, with a final appeal to the state supreme court. It is regretted that this feature has been omitted.

On the other hand, the citizens of Portland are indeed to be congratulated upon voting down the "home rule" bill, thereby accepting jurisdiction under the state-wide commission. An instance of the ridicule to which the California "home-rule" exposes their municipalities is that of the Pasadena incident. The city of Pasadena recently complained to the California Railroad Commission that the Southern California Edison Company had reduced its rate in Pasadena to a point which makes it impossible for a profitable operation of the municipal lighting plant in that city. The complaint charged that the rate instituted by the Southern California Edison Company is discriminatory in that other municipalities served by this company are charged at a higher rate. The state commission promptly ruled that it has no jurisdiction in the case. Without entering into the merits or demerits of the points at issue, it is clearly evident that Pasadena is placed in an anomalous condition. Here it is seen that a competitor has legal authority, not only over the franchise, but also over the rates of the other—a condition wholly at variance with all principles of justice and equity.

Summing up, then, all the various clauses in the new commission law of Oregon it would seem that this commonwealth is to be congratulated in having a good, workable enactment.

PERSONALS.

Virgil Cooper has resigned as superintendent of the Portland, Eugene & Eastern lines at Salem, Ore.

W. D. Dunsmore, manager of the Pavement Cutting Machine Company, has established his headquarters in the Foxcroft building, San Francisco.

W. W. Briggs, assistant general sales manager with the Westinghouse Electric & Manufacturing Company, is visiting the company's Los Angeles branch.

Hugo Altmayer, president and superintendent of the Farnsworth Electrical Works, has returned to San Francisco after an extended trip throughout the East.

George G. Devore, formerly local manager at Georgetown, Cal., for the Truckee River General Electric Co., recently joined the staff of the Oro Electric Corporation.

A. L. Pond, manager of the Chicago office of the Fort Wayne Electric Works of the General Electric Company, has returned to Chicago, after a brief visit to California.

William E. Lotspeich, Pacific Coast representative of the Colonial Electric Works, has returned to Warren, Ohio, by way of Seattle after an extended visit to California.

H. W. Crozier is expected to return to Sanderson & Porter's San Francisco office this week, after an extended investigation and public utility valuation at Tucson, Ariz.

R.G. McDonald, electrical and hydraulic engineer of the Mono-Home & Canal Company of Mono Lake, California, is a recent San Francisco visitor and is now in Los Angeles.

F. W. Bradley, mining engineer and capitalist, has been elected president of the re-organized Ocean Shore Railroad Company, which is building an electric road from San Francisco to Santa Cruz, Cal.

H. A. Noack, president of Pierson, Roeding & Company, and **F. A. Richards,** manager of the company's car department, are in the northwest, Mr. Richards having returned from an eastern trip this week.

Edward J. Duggan has resigned his position with the Levy Electric Company of San Francisco, as assistant to Mr. Louis Levy, and has taken up new duties at the local office of Holabird-Reynolds Company.

W. Zackert, formerly with the industrial sales department of the Great Western Power Company, is now acting as secretary to W. W. Briggs, assistant general sales manager of the Westinghouse Electric & Manufacturing Company.

John M. Eshelman and Max Thelen, members of the California Railroad Commission are attending the first convention of the recently organized Association of Public Utility Commissioners at Washington, D. C., November 19-23.

W. L. Goodwin, vice-president and general manager of the Pacific States Electric Company has returned to San Francisco after completing arrangements for his company to take over the Seattle store of the Holabird Electric Company.

R. B. Wolverton has assumed his duties as wireless inspector for the Pacific Coast, with offices in the Custom House building, San Francisco, succeeding **R. Y. Cadmus,** who has been transferred to Washington, D. C., at his own request.

F. G. Baum, chief engineer with the Pacific Gas & Electric Company, has returned to San Francisco after inspecting the work at the new Spalding dam. The engineering departments of the company have been housed in larger quarters on the seventh and eighth floors of the Grant Building.

H. P. Pitts, commercial engineer with the Pacific Gas & Electric Company, will attend the convention of the National Commercial Gas Association at Atlanta, Ga., on December 2-6, 1912. He will take credentials from the Pacific Coast Gas Association and the Panama-Pacific Exposition Company requesting that the association hold its convention at San Francisco in 1915.

Ralph U. Fitting, formerly with the engineering department of the Electric Bond and Share Company for four and a half years, has been engaged by Harris, Forbes & Company, New York bankers, as engineer. At the time of his resignation he was assistant chief engineer and had charge of all the gas construction work done by the company. Previous to graduating ,from Stanford University in 1906 he had been connected with the gas department of the Independent Gas & Electric Company of San Francisco; the engineering department of the Northern Pacific Railway Company at Tacoma, Wash.; the transmission line construction of the Puget Sound Power Company on the Electron Development; Tacoma substation construction for the Tacoma Railway & Power Company, and the drafting department of the Pacific Gas & Electric Company in San Francisco. After graduation he became identified with the gas business again and accepted a position as draftsman to the Portland Gas Company of Portland, Ore., and held the position of superintendent of distribution when he resigned about two months before coming to New York.

MEETING NOTICES.

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section, A. I. E. E., will be held in the assembly hall of the Electric building, Tuesday evening, November 19. W. D. Scott will present the paper of the evening on "Leased Wire Service on the Pacific Coast."

Oregon Electrical Contractors' Convention.

The date for the convention of the Oregon Electrical Contractors has been changed to December 17th and 18th, instead of December 10th and 11th, as announced last week, on account of the conflict with the jobbers' meeting on December 7, 8 and 9.

Portland Jovian Luncheon.

The regular weekly Jovian luncheon was addressed by C. C. Chapman, Secretary of the Portland Commercial Club. Mr. R. Hartley acted as chairman. His talk was a brief outline of some of the activities of the Portland Commercial Club in promoting the agricultural developments of Oregon.

San Francisco Engineers' Club

By far the largest attendance hitherto gotten together was present at the meeting of the San Francisco Engineers' Club last Tuesday noon at the Palace Hotel. A comprehensive plan was reported and decided upon, whereby the club will become a permanent fixture with club rooms and hotel facilities. Engineers interested both among the present membership and among coast engineers generally will be informed as to the interesting plans ahead.

Electrical Development League.

The regular monthly meeting of the Electrical Development League of San Francisco was held November 12. The regular routine matters were disposed of and a nominating committee consisting of C. E. Wiggins, H. B. Squires and S. J. Lisberger were appointed to select and make report at the next meeting of the League on nominees officers for the ensuing year. Walter A. Chowen general agent, of the Frankfort General Ins. Co. addressed the gathering on the "Various Phases of the Roseberry Liability Insurance Law and Its Effect Upon the Employers of Labor."

Engineering and Architectural Society of Portland.

The regular weekly luncheon of the Engineering and Architectural Society was held at the Hotel Portland, Tuesday, November 5. The feature of the meeting was an address by F. W. Newell, director of the Reclamation Service. After explaining the principle of storage reservoirs in arid districts to preserve the water for irrigation purposes, he went into some detail as to the money that has been expended by the government in this work and its results. He said that the appropriations, aggregating $75,000,000, had reclaimed 75,000,000 acres, or rather had placed them in a position to be reclaimed.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

SPECIFICATIONS FOR THE INSTALLATION OF MOVING PICTURE MACHINES AT PORTLAND, OREGON.

COMPILED BY F. D. WEBER.
(Concluded)

(f) **Portable Booths.**

(1) **When constructed of sheet metal and angle iron.**

Frame of Booth to be made of structural steel as follows: Four outside horizontal members at top and bottom. Four corner uprights and members supporting roof to be made of 1½"x1½"x¼" angle irons. See mark "A," Figures 1, 2, 3 and 4.

Intermediate uprights to be spaced every 2 feet, and to be made of 1½"x1½" angle irons or 2"x2"x¼" Tee irons. See mark "B," Figures 2 and 3.

Tee irons to which roof is attached to be made of 1½"x 1½"x$^3/_{16}$" Tee irons. See mark "C," Figures 1 and 4.

All joints to be made with a $^3/_{16}$-inch steel plate, to which each angle iron or Tee iron shall be riveted or bolted by the

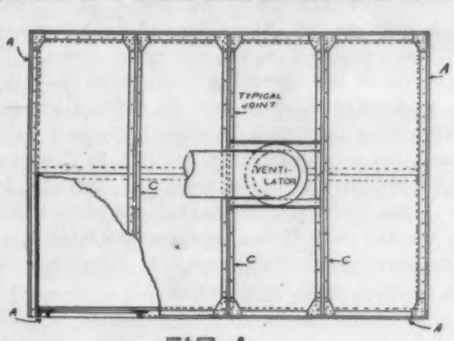

FIG. 1

use of at least two (2) ¼-inch bolts or rivets. See Figures 1, 2 3 and 4.

All bolts or rivets in frame to have flat heads, said heads always to be placed on exterior side of booth; all angle or Tee irons being so countersunk as to accomplish this result.

Frame to be built with a 6'x2" doorway (Figure 2); frame of said doorway to be built of 1"x1"x$^3/_{16}$" angle irons, which are to be joined together by the use of a $^3/_{16}$-inch steel plate similar to that shown in Figure 2.

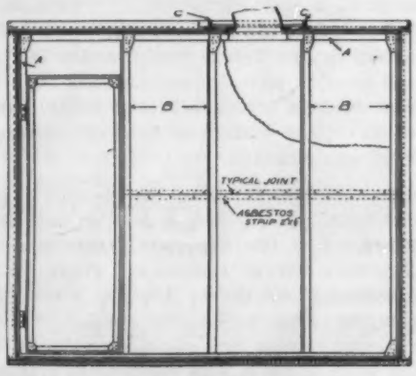

FIG. 2

Covering of Booth. The ceiling, walls and floor must be constructed of No. 22 U. S. Standard gauge (.0313 inches) galvanized sheet iron; all vertical joints between sheets must come over an angle or Tee bars, so that both sheets may be securely fastened to same. Horizontal joints between sheet iron strips may be fastened with riveted lap joints, allowing a lap of 1 inch and rivets placed at least every 2 inches apart. Iron sheeting must be fastened to frame by ¼-inch bolts. This booth must be so located that it will not be within 6 inches of combustible material unless the combustible material is protected by ⅛-inch asbestos. Entrance doors must conform to section (d) and all other openings must conform to section (b).

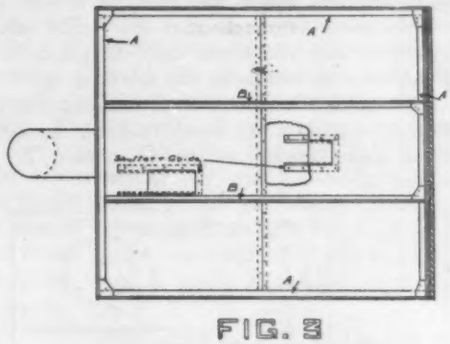

FIG. 3

(2) **When constructed of approved "plain asbestos wood" and angle iron.**

Frame. Same as above for sheet metal booths.

Covering of Booth. Sides and top of booth and door to be covered with approved "plain asbestos wood" of at least ⅜-inch in thickness, said boards to be so cut and arranged that vertical joints between boards shall always come over an angle or Tee iron, so that both boards may be securely fastened to the same. See Figure 6. After booth is com-

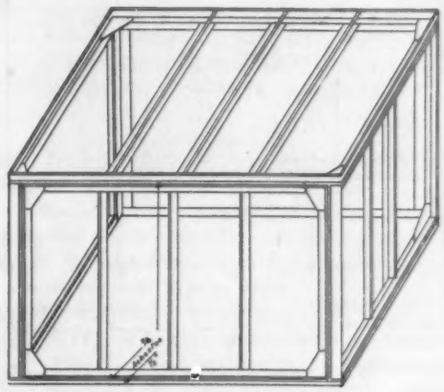

FIG. 4

plete, all openings where combustible material is exposed must be plugged with asbestos cement or equally satisfactory material. When joints of asbestos wood on the outside of booths do not come over angles of Tee irons the cracks between the boards shall be covered by a strip of asbestos wood at least ¼-inch in thickness and 2 inches wide, said strips to be securely fastened to both boards in such manner so as to cover the exposed joints. The above-mentioned strips and all asbestos wood shall be secured in the proper place by the means of proper bolts and nuts, said bolts and nuts to be spaced not more than 6 inches apart.

Flooring. Floors shall be made of two parts, an upper and a lower floor. Lower floor shall be made of asbestos wood, ½-inch minimum thickness. Resting on this floor shall be a floor made of asbestos wood of ⅜-inch minimum thickness. See Figure 7. Joints to be broken in this floor.

Entrance Doors must conform to section (d) and all other openings must conform to section (b), with the excep-

tion that for the small sliding doors over machine openings that it will be satisfactory to use one piece approved "Plain" asbestos wood of at least ½-inch thickness in place of metal and asbestos doors, as specified in this paragraph.

Asbestos Wood. Whenever asbestos wood is referred to in this pamphlet it shall be understood to mean approved "Plain Asbestos Wood."

(g) **Combination Booth.**

(1) **When picture machine booths are constructed of brick, reinforced concrete or standard hollow tile in combination with asbestos and lock-jointed metal,** it will be necessary to so construct these booths so that the joints between the fireproof material and the metal shall be thoroughly tight. This is to be done by recessing the metal at least 4 inches and with a 1-inch right angle bend at recessed end into fireproof material. All openings must conform to section (b) and entrance doors must conform to section (d), except

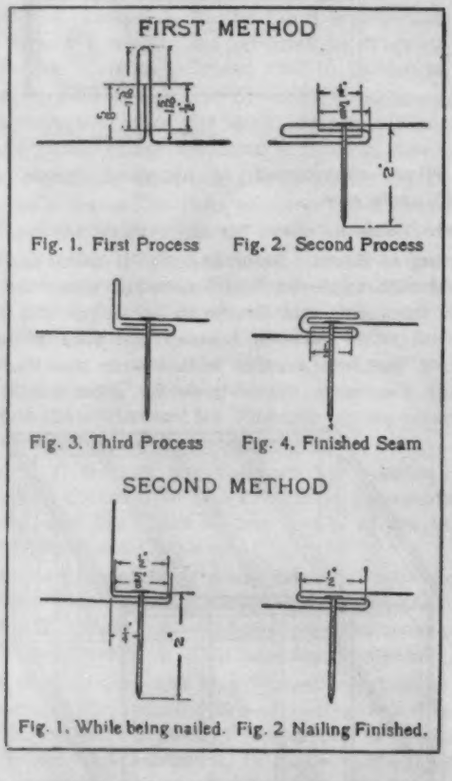

Fig. 1. First Process Fig. 2. Second Process

Fig. 3. Third Process Fig. 4. Finished Seam

Fig. 1. While being nailed. Fig. 2 Nailing Finished.

where these sections refer to nails, and in these places lead expansion sleeves and bolts must be substituted when guides, etc., are fastened to fireproof material.

(2) **When booths are constructed by using floor joists covered with "ship-lap" for ceiling "backing," the floor being of wooden crib construction, both covered in a standard manner with asbestos and lock-jointed iron, with the sides all constructed of metal, the following construction must be followed for the side construction:**

Metal studding must be placed on at least 6-inch centers for vertical supports and with at least four metal studdings spaced equally distant apart, running horizontally around the sides of the booth. Every cross of studding to be tied with iron wire. The metal studding to be bolted to a 1½"x 1½"x¼" angle iron at top and bottom. The angle irons must be screwed to the woodwork at the top and bottom of the booth with 1-inch wood screws spaced not farther than every foot. The sides to be covered by No. 22 U. S. Standard gauge galvanized sheet iron, the same to be riveted together with a 1-inch lap, the rivets to be not over 2 inches apart. The side lining must be riveted in the same manner to the floor and ceiling covering as above. The side 18 inches apart with 1"x1"x1/16" strap iron riveted to the lining. All door hangings and guides or any attachments must be riveted to the sides of booth in a substantial manner. lining must also be tied to the metal studding at least every

Also around openings in the booth the lining must be kept smooth and free from buckling, and it may be necessary to furnish more metal studding at these points to obtain this condition. Outside walls of booth must be covered with metal lath and cement plaster. Entrance doors must conform to section (d) and all other openings must conform to section (b).

(h) **Methods of Construction Not Specified.**

To avoid all misunderstandings in the future, when any special construction, not covered in this pamphlet is contemplated, the same should be taken up with the Inspection Department of the Bureau.

11. **Machine Stands and Shelves** in booth must be entirely of metal or of wood, covered with the same fire resisting material as the booth itself.

12. **Protective Features.** No waste paper, newspaper, old clothes, rags, or in fact anything of an inflammable character will be permitted in the operating room. The walls and the floors of the operating room must be kept clean; under no circumstances must dust be allowed to accumulate. Waste will not be permitted in operating room; such wiping rags as may be necessary must be kept in approved waste can. Under no circumstances must the operator leave the operating room without first having disconnected the current from the arc lamp of the machine. Smoking is positively prohibited. One chemical extinguisher, 2 buckets water and 2 buckets of sand must be provided.

TRADE NOTES.

The "Holophane Works of General Electric Co." has been adopted as the name of the organization manufacturing Holophane, Holophane-Dolier, Iris, Veluria, Clear-cut and Nobblac Glassware, etc., this being the legal successor to Nelite Works of General Electric Company.

The Pelton Water Wheel Company report an order from the Idaho Consolidated Mines Company for an 850 h.p. Pelton-Francis turbine to operate a 500 kw., 600 r.p.m. General Electric alternator, three-phase, 220 volt, for use in a new plant near Port Hill, Idaho, which is being exploited by the American Smelting & Refining Company. The operating head is about 190 ft. A Pelton oil pressure governor will be operated in connection with a Pelton synchronously operated relief valve to avoid altering pipe line velocities, a heavy fly-wheel also being provided to insure accurate speed regulation to take care of the great variations in load consequent upon running mining equipment.

The Crocker-Wheeler Company has recently installed two 25 cycle, 4500 k.v.a., three-phase, core type butt joint water cooled transformers at the Superior transformer station of the Great Northern Power Company. These transformers were put to a sudden and severe test just a few hours after they were ready to be put into regular service. On one of the towers of the transmission line running to the Duluth transformer station which is tied in with the Superior station. the six insulations were shot to pieces by rifle bullets, evidently with malicious intent, thereby putting out of service the transformers in this station. As this occurred just at the beginning of the peak load period each of the two Crocker-Wheeler transformers at Superior had to carry upwards of 6000 kw. until the damaged lines had been repaired and normal service restored.

NEW RULES OF SAN FRANCISCO DEPARMENT OF ELECTRICITY ON EXTERIOR ILLUMINATION.

(Adapted from Rule 83, National Electrical Code.)

In addition to the conduit method for exterior illumination, metal trough construction will be permitted under the following regulations:

Local Rule No. 55.

a. Material.

Must be constructed entirely of metal or other approved non-combustible material.

Sheet metal must be not less than No. 28 U. S. metal gauge.

All metal must be galvanized, enameled or treated with at least three coats of anti-corrosive paint, or otherwise protected in an approved manner against corrosion.

b. Construction.

Must be so constructed as to insure ample strength and rigidity and securely fastened to the building.

Must be so constructed as to be practically weatherproof and so as to enclose all terminals and wiring other than the supply leads. Supply leads must be brought into the body of the structure in approved rigid conduit.

No part of this structure must be concealed or embedded in any manner, but must be entirely exposed on the exterior of the building.

Cut-outs, transformers, unless of weatherproof type, flashers and other similar devices on or within the metal trough structure, must be in a separate, completely enclosed, accessible and weatherproof compartment, or in a substantial weatherproof box or cabinet of metal of thickness not less than that of the structure itself.

Each compartment must have suitable provision for drainage through one or more holes each not less than one-quarter inch in diameter.

c. Marking.

Must have the maker's name or trade-mark permanently attached to the exterior.

d Receptacles (Weatherproof).

Must be so designed as to afford permanent and reliable means to prevent possible turning; must be so designed and placed that terminals will be at least one-half inch from other terminals and from metal of the structure.

Miniature receptacles will not be approved for use in this work.

e Wiring.

Must be approved, double-braided, rubber-covered wire not less than No. 14 B. and S. gauge.

Must be neatly run, and so disposed and fastened as to be mechanically secure.

Must be soldered to terminals, and exposed parts of wires and terminals must be treated to prevent corrosion.

Must, where they pass through walls or partitions of the structure, be protected by approved fitting.

On outside of structure must be in approved rigid conduit.

f.

Not over 1320 watts must be dependent upon final branch cut-out, nor more than twenty-four (24) receptacles on any one circuit.

g. Grounding.

All metal parts of structure must be permanently and effectively grounded.

h. Inspection.

All metal trough construction must be inspected in shop and preliminary approval obtained before erection upon the building.

Note.—Sections "d" and "k" of Rule No. 17 of the "1911 Local Installation Rules" have been repealed.

NEWS OF SAN FRANCISCO ELECTRICAL CONTRACTORS.

John G. Sutton Company has been awarded the electric work for St. Francis School.

The McFell Electric Company have been awarded the electric work on the Insurance Exchange by Willis Polk, architect.

The Standard Electric Construction Company were the lowest bidders on the Starr King School, on the southeast corner of Twenty-fifth and Utah streets. The bids were: Standard, $1924; National Electric Company, $1996; General Electric Construction Company, $2100; John G. Sutton, $2198; Turner Company, $2498.

Bids for the Sacramento Armory were opened and the bidders were: Central Electric Company, $2244; Scott, Lyman & Stack, $1950; Standard Electric Construction Company, $1694. The bids were all rejected and the work will be done by day labor. This work has been figured four times and the man who will do the work has never been called on to give a public figure.

Four sets of figures on almost the same set of plans satisfies the writer of the impossibility of the State Engineer's office to do the work as cheap as the lowest bidder has offered to do it.

The Treasury are calling for bids on the new Sub-Treasury biulding. About $500,000 will be spent on same.

A large hotel at Spokane is being figured by a number of local contractors. It has been reported that electrical work will run close to $100,000.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

November 2.

The San Jose Terminal Railway Company filed an amended application for permission to issue $200,000 of 5 per cent bonds for the construction of an electric railway from San Jose to tidewater at Alviso, and the establishment of a boat service between Alviso and San Francisco.

The Ojai Power Company applied for a certificate of public convenience and necessity to sell electric power in Nordhoff, Ventura County, and for permission to issue $25,000 of capital stock.

November 4.

The San Joaquin Light & Power Corporation applied for authority to issue $925,000 of bonds to take up and refund notes which the company has given to banks and individuals for money borrowed and used in construction work. Permission is desired to issue $320,000 of these bonds at the present time and the balance at a later date.

W. L. Childers applied for authority to lease the Crescent City Water Works and to give an option to purchase to James H. Owen. James H. Owen joined in the application, asking for authority to assign the lease to the Mountain Power Company.

The Railroad Commission issued an amended order correcting a date as to the maturity of bonds previously authorized upon application of the Pacific Electric Company.

November 5.

The Pacific Telephone & Telegraph Company applied for permission to purchase the stock and to take over the properties of the San Gabriel Valley Home Telephone Company.

The San Diego Consolidated Gas Company applied for permission to execute a supplemental deed of trust to convey to the trustees, the Harris Trust and Savings Bank and the Los Angeles Trust and Savings Bank, additional properties newly acquired by the corporation.

November 6.

The Commission rendered a decision granting permission to the West Coast Gas, Light & Fuel Company and the Home Gas & Electric Company of Newport Beach, Los Angeles county, to consolidate and to issue new securities. The consolidated corporation, to be known as the West Coast Gas Company, is empowered to issue $91,075 of stock and $100,000 of bonds.

INDUSTRIAL

INCIDENTS IN THE DEVELOPMENT OF CABLE MANUFACTURING.

The first cable of which there is any record was laid at Birmingham, England, in 1837. It was composed of a number of gutta-percha covered wires encased in an iron pipe. Owing to the imperfect protection afforded by the pipe its life was very short.

During the next half-century the problem of an efficient protective outside casing for the wires remained the most difficult one in cable manufacture. The period from 1837 to 1880 was largely one of experiment. Many varieties of telegraph and telephone cables were tried out during that time, but all developed that fatal defect of being non-moisture-proof when laid underground.

In 1880 a cable was finally introduced which attained some measures of success. It consisted of cotton-insulated copper wires bound together and drawn into 200-foot sections of lead pipe; the interior of the cable thus formed was then thoroughly saturated with paraffin throughout its entire length.

It was with one of this type that the Western Electric Company began its manufacture of cable in 1882 and continued with little change until 1891, when paper insulated conductors were introduced. The substitution of paper insulation for that of wool or cotton resulted in such a remarkable improvement in transmission and such a decided reduction in cost, that the paper core cable has almost completely displaced the older types.

Of the four principal manufacturing operations through which cable passes—insulating the copper wires, pairing the insulated wires, winding the wires into a cylindrical core, and sheathing the core—the insulating and sheathing processes only have undergone important changes.

The insulating operation was radically changed when the use of paper was inaugurated a new design of insulating machine becoming necessary. The first method of applying paper insulation was to pull the wire through a die which folded a ribbon of paper lengthwise around the wire. Spirals of different colored threads were then wound around the insulated wire in order to keep the paper binding in place, the various colors serving to distinguish the different pairs of wires. This method is still employed by foreign manufacturers in the insulation of the coarser gauges of wire.

In America, however, it was almost immediately replaced by our present method, in which the paper ribbon is wrapped spirally around the wire; the covered wire being afterward run through a bushing ("polisher") in order to bring it to the required diameter.

The first type of machine used for this purpose was necessarily slow, as the supply of paper that was wound on a comparatively small bobbin could not be revolved about the wire at a very high speed. About 1897, however, a much faster machine was developed. Is this a revolving disk carries a pad of paper tape upon its face. As the disk and the pad revolve together, the paper is unwound at the same rate of speed, regardless of the size of the pad. The design of this machine has been constantly improved until at present the paper insulation can be wound around the wire at the rate of 2800 turns a minute.

The lead sheathing operation was, in the beginning, a very tedious and expensive process. At that time the lead pipe was purchased in approximately 200-foot lengths. Four of these usually constituted a cable length, and were laid out straight on the floor to receive the core. In order to start the cable core through the sheath, a ball attached to a cord was forced through the pipe by means of a hand air pump—something like a bicycle pump. To the cord was attached a rope, by means of which the cable was drawn through.

The men employed to do this kind of work had to be a combination of sailor and plumber, as they had first to pull the core into the lead sheath, and then solder the joints. The plumbing work followed the "drawing-in" operation, the ends of the pipes being brought together and the joints wiped in the regular way, except that the diameter of the joints was made as small as safety would allow.

After the sections had been joined the length of sheathed cable was wound on a drum and placed in an oven. Here, by means of a vacuum, melted paraffin was forced through its entire length until the core was saturated. The finished cable was then rewound on wooden reels ready for shipment.

In 1892 this slow and laborious process was replaced through the efforts of W. R. Patterson, of the Western Electric Company. By an ingenious invention, known as the "die block," he made it possible to form a continuous lead sheath around the core as it passed through a chamber filled with plastic lead. This process, which gave the name "Patterson cable" to the product, is, with some improvements in the die blocks and presses, still employed in forming the sheath.

The change to a continuous sheath made it possible to omit the saturation of the core with paraffin, as the cable could be taken direct from an oven and passed through the presses without any danger of its taking up moisture.

NEW CUTLER-HAMMER RECEPTACLES.

The increasing use of household electric heating devices and small motor-driven devices has created a demand for plug receptacles, because it is not always convenient or desirable to feed these devices from the fixture socket. The attachment plug receptacles illustrated below have recently been put on

Wall Attachment Plug Receptacles.

the market by The Cutler-Hammer Manufacturing Company of Milwaukee to fit in with their line of porcelain and composition attachment plugs. The caps for the three styles of receptacles and the attachment plugs are identical, so that where the plugs are already in use the receptacle without the cap can be installed, unless, of course, a separate cap is desired. White porcelain and black composition caps are furnished same as with the attachment plugs.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—Olston Electric Stove Company, $25,000, shares $1 each, subscribed $3, by W. F. Cochran, Otto Olston and Jos. Rosenburg, 1 share each.

SALT LAKE, UTAH.—The Interurban Construction Company, which was incorporated under the laws of Maine some time ago, has filed a certified copy of its articles of incorporation. The object of the company is to construct the Salt Lake and Utah Railroad which is to be an interurban line beween Salt Lake City and Layson. The company is capitalized at $1,500,000, and the temporary organization that was formed in Portland, Me., has E. A. Turner of that city for president, F. M. Orem of Salt Lake for treasurer, and Carl W. Smith as additional director.

ILLUMINATION.

LONG BEACH, CAL.—A movement is on foot here to establish a municipal electric lighting system at a cost not to exceed $100,000.

MT. VERNON, WASH.—The Pacific Northwest Traction Company has been awarded the contract for furnishing city light for a period of five years.

MT. VERNON, ORE.—The contract for the city lights has been let to the Pacific Northwest Traction Company to furnish the city with light for five years.

SANTA BARBARA, CAL.—The Reynolds Electric Supply Company has placed an application before the board for a franchise for the Carpinteria lighting system soon to be installed.

LAS VEGAS, NEV.—It has been decided to install 115 eighty-watt tungsten lights in such manner as to light the whole city, according to plans and specifications furnished by the Western Electric Company's expert.

SEATTLE, WASH.—An ordinance has been passed which provides for a $425,000 bond issue, the money to be expended in building an auxiliary steam, light and power plant in the city. The matter will be placed before the voters in the March election.

HILTON, ORE.—An election has been called for December 10 for the purpose of submitting to a vote of the people the proposition of bonding said city for the sum of $18,000 to be expended for the enlargement, extensions and improvement of the city electric lighting system.

SAN JACINTO, CAL.—J. W. Tibbot, G. B. Tibbot and Claude H. Webber have purchased the gas plant of this place. A car load of machinery has been received and is being put in place. Extensions will be made and everything done to give people an efficient and satisfactory gas service.

CHEHALIS, WASH.—A contract has been signed by the Washington Electric Company and the Ostrander Railway & Timber Company, whereby the local concern is to furnish light and power for the city of Ostrander. A substation will be installed in a central location at Ostrander for the distribution of the electric energy.

PORTLAND, ORE.—The Northwestern Electric Company has been granted a franchise for a period of 25 years to enter the local field in competition with the Portland Railway, Light & Power Company. Work on the White Salmon, Wash., power plant will be rushed to completion, as will the business pertaining to the terms of the franchise.

PORT ANGELES, WASH.—The new dam of the Olympic Power Company on the Elwah River has been washed out. A portion of the Port Crescent road was destroyed and the county bridge is a total loss. The dam with its mechanical equipment represents $500,000. Allen E. Ransom, assistant superintendent of the company, states that work of repairing the damage will be begun immediately.

EL PASO, TEX.—The Texas Light & Power Company, an east Texas and New York syndicate, has obtained control of the El Paso Gas & Electric Company from the Chicago company, which owned it. It is reported that the same company has filed a chattel mortgage to the Bankers' Trust Company of New York, as trustee, for $30,000,000, for the purpose of extending and improving its plants.

SAN DIEGO, CAL.—Notice is given to all stockholders of the San Diego Consolidated Gas & Electric Company that the board of directors has adopted a resolution to hold a meeting on December 23, for the purpose of considering and acting on the proposition that the company increase its bonded indebtedness not exceeding $3,000,000, said bonds to be issued for the purpose of discharging floating indebtedness of corporation; bonds payable not later than December, 1922, bearing interest at rate not to exceed 6 per cent per annum.

TRANSMISSION.

SILVER CITY, N. M.—The Water & Electric Light Company is surveying a line to connect its power house with the 85th mine. All power used at the mine will be supplied by this company.

CORONA, CAL.—The Consolidated Reservoir and Power Company hereby levies an assessment upon its capital stock to the amount of $5.00 per share, for the purpose of extending its pipe lines to the Barker lands.

REDMOND, ORE.—At a special meeting of the city council a franchise was granted to Geo. Jacobs of Portland, for an electric light and power plant in Redmond, same to be constructed and in operation within 60 days. The new plant will furnish a 24 hour service.

DOUGLASS, ARIZ.—The Douglass Traction & Light Company has a force of men at work constructing a high tension lead to connect with the Copper Queen smelter. This will act as a safeguard guaranteeing a supply of electricity should the city plant break down at any time.

LOS ANGELES, CAL.—Notice is hereby given the Citizens Trust & Savings Bank, successor to the interests of the Broadway Bank & Trust Company, that bonds of the Salinas Water, Light & Power Company were called for payment November 4. Upon presentation of said bonds and surrender thereof the premium provided in the deed of trust, and par value will be paid the owner.

PHOENIX, ARIZ.—The Corporation Commission, after reconsideration on the application of the Williams Electric Light & Power Company, at Williams, has decided to allow the new concern to take over the assets and will issue an order to that effect in a few days. The hearings in the Williams matter, however, are not yet completed. The Williams company has also an application for permission to place $250,000 bonds on the market for the purpose of constructing improvements of the present plant.

RANDSBURG, CAL.—Work on the high power line of the Southern Sierras Power Company is being pushed rapidly and will be completed to Bishop in Inyo County soon. Officials of the company state that the line will be completed for the delivery of juice from the Inyo power house by the first of the coming year. The lines were held up by right-of-way troubles in the aqueduct district for some time, causing a long delay, but that has long since been settled and for some time the work has been ropidly pushed. In San Bernardino and Riverside counties 175 miles of distributing lines were built at an average cost of $1000 a mile. More than 75 pumping plants have been connected up and others are being supplied as fast as possible. The telephone line running parallel with the power line from San Bernardino to Bishop and connecting Randsburg with coast points was finished to Bishop last week. The substation east of town is completed and ready for service.

TRANSPORTATION.

EUGENE, ORE.—The Oregon Electric Railway Company will erect a $20,000 passenger depot here.

VICTORIA, B. C.—Residents of Bay street have petitioned the B. C. Electric Company for an extension of the line into their territory.

EUGENE, ORE.—It is rumored in this city that the Oregon Electric Company will extend its line from Eugene to Roseburg, work to be begun in the spring.

NORTH BEND, ORE.—F. L. Sturm, a North Dakota capitalist, is looking over the territory in this section with a view of establishing a street car system between this city and Marshfield.

NEW WESTMINSTER, B. C.—The B. C. Electric Railway Company may build a line from this city to Port Moody. The Board of Trade and Progress Association are back of the movement.

CENTRALIA, WASH.—The Washington Electric Company, which proposes to construct a line from Vancouver, Wash., to Tacoma, has applied for a franchise to operate through this city.

EUGENE, ORE.—The Oregon Electric Railway Company will have a complete car repairing plant in Eugene, the contract having been let in Portland to La Deaux & La Deaux of that city for the erection of the building.

LOS ANGELES, CAL.—Detailed plans are being prepared in the architectural department of the Pacific Electric Railway Company, for the new terminal station at Sixth and Los Angeles streets, to be of brick construction.

BOISE, IDAHO.—The Idaho Traction Company has been granted permission to lay tracks on certain streets of this city. The company named has also applied for a permit to construct three sidings on city streets for passage of cars.

CENTRALIA, WASH—The Washington Electric Company, recently incorporated under the laws of Oregon for the purpose of constructing an electric line through Centralia from Vancouver to Tacoma, has secured an option on the old grade and right of way of the T. O. C. V. Railway. It is reported that work on the new line would begin about November 15.

PORTLAND, ORE.—In carrying out its plan for the electrification of the Willamette Valley and the establishment of a suburban service of the utmost importance to Portland business interests, the Portland, Eugene & Eastern Railway Company, has purchased from the Portland, Railway, Light & Power Company the nine-mile stretch of railway track known as the Willamette Falls Railway, and in part will utilize the old road as a portion of the new main line from Portland to Salem.

SACRAMENTO, CAL.—Changes have been made in the schedules of the Central California Traction Company, running between this city and Stockton, so that better connections can be made with Santa Fe passenger trains at Stockton. The schedule change follows an order of the State Railroad Commission directing the Santa Fe to grant through joint rates in connection with the electric line. The train that now leaves here at 2:15 p. m. will hereafter depart at 2:10 in the afternoon; the train that formerly left at 6 p. m. will not leave until 6:20 p. m. under the new schedule, and the train which now leaves at 10:10 p. m. will leave at 9 p. m. Of the trains coming to Sacramento from Stockton and Lodi, that which now gets here at 8:30 a. m. will arrive at 7:45 a. m.; that which now arrives at 9:42 p. m. will reach here at 10:20 p. m., leaving Stockton at 8:30 p. m. instead of 8 p. m. Mandatory through rates between the Traction and the Santa Fe became effective on October 10.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has filed its application for a franchise for operating over the tracks of the proposed municipal railway on San Pedro street from Aliso to Ninth streets. The application contains a clause covering the use of Los Angeles street in case the Pacific Electric is forced to vacate San Pedro street. The application was referred to the board of public utilities to report back to the Council. The utilities board will approve the notice of sale of this franchise and return it, with the board's report on the franchise application, when the council will authorize the publication of notice of sale of the franchise, according to the prearranged plan. This arrangement is the result of the final compromise on the long-drawn-out San Pedro street franchise question and the plan to relieve Main street traffic congestion. According to the compromise the Pacific Electric is to bid for the contract to build the line as a part of the municipal railway to the harbor. The company will take a revocable franchise to use the tracks from Aliso to 9th streets, with the condition that if the franchise on San Pedro street is revoked inside seven years the company will go on Los Angeles street with a total tenure of not more than ten years on the two streets, in case the city wishes to take over the line.

TELEPHONE AND TELEGRAPH.

POMEROY, WASH.—The telephone company contemplates stringing more cable and providing for larger phone facilities.

RAVALLI, MONT.—Telephone connections between this place and Polson will be established by the Mountain States Telephone & Telegraph Company.

ENTERPRISE, ORE.—The Home Telephone Company intends to improve its lines in Wallowa county. Work on the line between this city and Joseph will start at once.

MARTINEZ, CAL.—The Pacific States Telephone & Telegraph Company is arranging to build a telephone line from Suisun to Grizzly Island, a distance of about 15 miles.

SEATTLE, WASH.—The proposition of issuing bonds for the establishment of a municipal telephone system will be placed before the voters at the general election, March 4.

PT. ORCHARD, ORE.—Ellis Bros. have been awarded the contract for furnishing telephone poles and installing same for the Six Elk Telephone Company from this city to the Elk River.

EL PASO, TEXAS.—Long distance telephone wires for the new route from El Paso to Las Cruces already reach Anthony, N. M. The new line will be five circuit and ten wires, and is being strung from El Paso to the New Mexico state line by the Tri-State company and from that point on to Las Cruces by the Mountain States company.